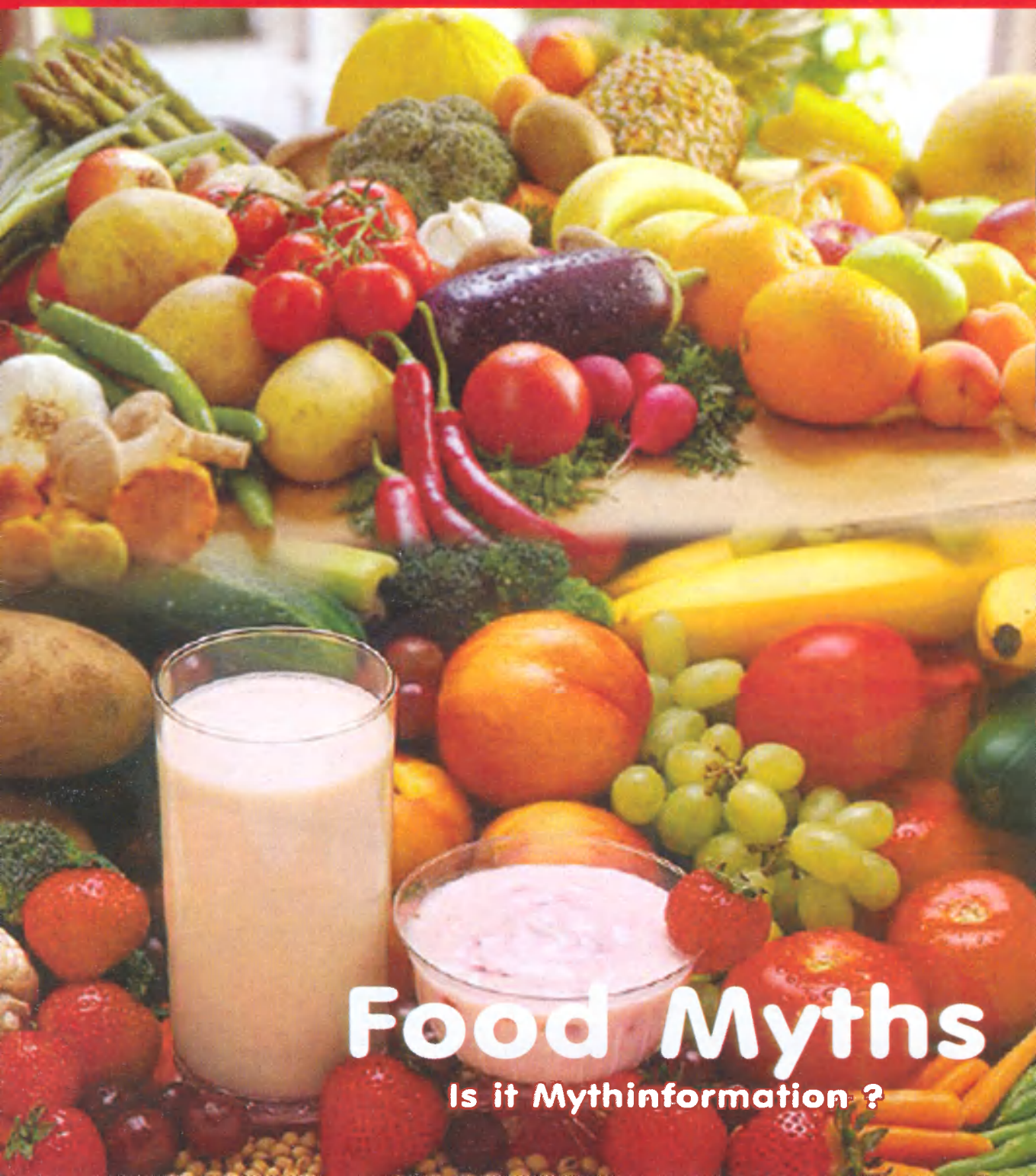




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# SCIENCE INDIA

THE NATIONAL  
SCIENCE MAGAZINE



## Food Myths

Is it Mythinformation ?



# IIES 2011

1st India International Energy Summit

प्रथम भारत अंतरराष्ट्रीय ऊर्जा सम्मेलन

28th - 31st January 2011

VNIT Nagpur, India

## INDIA INTERNATIONAL ENERGY SUMMIT



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# Editorial



For years we've been trying to banish butter from our diets in favour of "healthier" options. But now scientists have found that it is no more likely to raise blood cholesterol and has always been a good source of Vitamins A and D. The study, by nutritionists at Lund University, in Sweden, discovered that butter fat is used as an energy store rather than entering the bloodstream.

Eating spinach makes you strong. Researchers at Rutgers University in New Jersey found a steroid in leafy greens like spinach that increases the production of muscle protein. But you'll not look like Popeye unless you eat more than a kilo of spinach daily.

Raw foods make more nutrition sense than processed foods. Well, some, not all. Fresh crisp salads and fresh fruits are a great idea but that does not necessarily mean that anything that is frozen, dried or cooked is not good. Besides, a lot of raw foods may contain undesirable bacteria, while processing of some sort can clean them up. Best examples - canned carrots have more absorbable beta carotene than fresh carrots while frozen peas can provide more Vitamin C than ones that have been stored in their shell for a few days. Tomatoes and carrots release the anti-oxidating carotene only on cooking, so raw veggies are not always a great idea. And did you know, potatoes are indigestible if eaten raw?

Excessive sugar causes Diabetes. No, never, only when one gets diabetes, it's a good idea to go low on sugar. The cause of diabetes is lack of insulin, not excess of sugar. Excessive consumption of sugar may, however, cause other health related problems but to blame it for diabetes is unfair.

No cold drinks if just in from hot sun. This is a very commonly held view in hotter countries, attributing the sudden change in temperature as the reason for cold or worse. Exposure is the culprit, but doctors have not found any scientific evidence to support this belief, so it may just be a grandma's idea that we prefer to follow.

This is not the first time received wisdom has been proved wrong on food. The cover story of this issue is 'Food Myths' - Is it Mythinformation ?

**Team Science India**





# FOOD MYTHS

IS IT MYTHINFORMATION ?

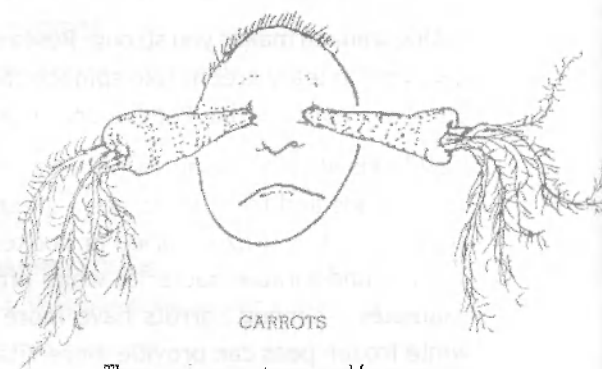
Dr. A.R.S. Menon

Despite impressive advances in food science in recent decades, and notably in identifying the role certain foods play in improving health, myths about foods still persist. Most of us will be familiar with one of the following - "oysters are aphrodisiacs", "food colourants make children hyperactive" and "spicy food causes ulcer". But how many of us believe these statements to be true? This article looks at three popular food 'myths' in more detail and attempts to unravel whether they are based on science fiction or science fact.

## **'Eating carrots will help you see in the dark'**

This claim has its 'roots' in World War II. To prevent Germany from finding out the

real reason their aircrafts were suddenly being shot down in large numbers by the RAF (Airborne Interception Radar), Britain's Air Ministry spread the word that RAF pilots were being fed a diet of carrots which



They say that carrots are good for your eyes,  
They swear that they improve your sight.  
But I'm seem' worse than I did last night—  
You think maybe I ain't usin' 'em right?



helped them see enemy bombers at night! It was already known at that time that carrots contained Vitamin A, which is essential for healthy eyesight, and the humble carrot was one vegetable in plentiful supply. The slogan "Carrots keep you healthy and help you see in the blackout" was also used extensively, and carrots were promoted heavily in the 'Dig for Victory' campaign. This claim became so persuasive to the British public during World War II that carrots were consumed in large amounts, even becoming the main ingredient in mouth-watering recipes such as carrot fudge, mock apricot tarts and carrot jam. There was also a homemade beverage called carrolade made from swede juice and carrot juice. Is there any



## IT IS UNWISE TO SWIM WITHIN ONE HOUR OF EATING

This myth dates half a century back when the American Red Cross has published an instruction on life-saving saying that swimming immediately after meal may cause stomach cramps and even death. But later this theory was questioned. Many swimmers assert that they usually cover long distances during training sessions immediately after meal.

scientific evidence to suggest that carrots make you see better in dark? The answer is no for people with otherwise healthy eyesight. However, Nyctopia (night blindness), a disorder of cells in the retina responsible for vision in dim light, can be caused by Vitamin A deficiency. The condition is improved by eating more Vitamin A rich foods, including eggs, meat and fish, and not just carrots!

### **'Fresh fruits and vegetables are more nutritious and healthier than frozen or canned fruits and vegetables'**

Fruits and vegetables are important for health, but are fresh better than the rest? At the moment they are picked that this is undoubtedly true but not everyone can benefit from growing their own produce, and most of us buy fruits and vegetables from a grocery or supermarket.

When purchased from a grocery or supermarket, fruits and vegetables have usually traveled some distance to get there, especially if they're out of season. Harvesting, packing and transportation can take days, and during this time valuable minerals and nutrients may be lost. For some vegetables this loss can be

large, e.g. spinach and green beans can lose up to 70% of their Vitamin C content within seven days of harvest, even under recommended storage conditions. Contrast this situation with frozen fruits and vegetables, which are often packed and frozen within hours of being harvested and before being transported. Freezing ensures that valuable minerals and nutrients are not lost prior to sale. Not all fruits and vegetables are frozen after harvest, but those that are, e.g. peas, are highly nutritious after cooking.

It is also believed that canned fruits and vegetables are less nutritious than fresh or frozen. Although the levels of some Vitamins and minerals are reduced by canning, others remain unaffected or may be increased. E.g. research has shown that canned apricots contain as much Vitamin A as fresh or frozen apricots, and the Vitamin C content of canned asparagus is higher than that of cooked asparagus. Canned tomatoes have higher contents of absorbable lycopene (a dietary antioxidant) than fresh tomatoes.

Evidence would suggest, therefore, that fresh, frozen or canned fruits and vegetables are all healthy and nutritious,

## CHILDREN SHOULD EAT MUSHROOMS

Mushrooms are often included in children's diet. However, you shouldn't do that, as children do not generate enzymes needed to process the protein contained in mushrooms. That is why children get food poisoning from eating even small portions of edible mushrooms. The consequences of mushroom poisoning are equally disastrous for children and elderly people.



and that this particular myth can be misleading.

**'Drink at least eight glasses (or two litres) of fresh water each day'**

Under normal circumstances the human body can lose up to 2.5 litres of water each day, and that water needs replacing if we are to stay healthy - but is there any medical justification for drinking eight glasses of water each day? Where did this guideline come from?

Although its exact origin is unknown, it may have started in 1945 when dieticians at the US Food and Nutrition Board suggested that a person should consume 1 ml of water for each calorie consumed. A daily diet containing approximately 1900 calories, therefore,

equals nearly 2 litres of water, 64 fluid ounces or eight 8-ounce glasses which became the well-known "8 - 8" rule. However, what dieticians at that time failed to realize was that water in fresh foods can contribute substantially to a person's daily intake. For example



### COFFEE NEGATIVELY AFFECTS PREGNANCY

It has been proved that caffeine does not affect healthy development of fetus and is unrelated to miscarriage. But according to recent American studies, pregnant women should refrain from coffee as well as from coke or any other drink containing caffeine.





## COFFEE CAUSES A RISE IN BLOOD PRESSURE

This statement is disputable. Australian researcher Jack James in his 1998 study showed that three to four cups of coffee taken in the course of the day tend to slightly increase the lower level of blood pressure. However, such a rise in pressure can be caused by an emotional dispute with your friend or even by the sight of a doctor holding a tonometer and coming up to you. The English doctors say that the "hypertonic" action of coffee is short lived, and does virtually not affect its regular drinkers.



strawberries and watermelons are 92% water and radishes are 95% water. Although consuming two litres of water daily is good guideline, it does not have to be in the form of eight glasses of fresh water, and there is no medical evidence to support consuming this amount. Drinking cups of tea, coffee or other beverages (such as fruit juices) also contributes to the daily intake of water. Although some beverages contain caffeine (a diuretic), at least 50% of the water consumed is retained by the body. It would seem, therefore, that provided a person's diet is healthy and balanced this claim is not exactly tight.

## So, is it a case of mythinformation?

Only three myths have been discussed in this article but they appear to have one thing in common which may be true of all food myths - they all make scientific statement which is not entirely in agreement with scientific fact. Despite this, food myths appear to have a powerful effect on the food choices of some people. This could be because they convey a very simple, short and memorable message about how a particular food may or may not be beneficial to health. However, it's also because of this that they should be treated with caution. An apple a day will keep the doctor away - but only when it's included in a balanced diet.

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## LEMONS ARE SOUR BECAUSE THEY LACK SUGAR AND RICH IN VITAMIN C

In fact, one kilo of lemons has more sugar than one kilo of strawberries. As for Vitamin C, its content in strawberries is higher than in lemons. Lemons are highly valued for many other beneficial substances, or antimicrobial and antiseptic properties rather than for their Vitamin C content. For this reason lemons are long since known to have been used against cold, flu, sore throat, inflammatory diseases of the palate etc.

# Delicious Mushrooms – A Source of Multinutrients

Dr. Dipali Majumdar

Mushrooms are the reproductive structures of edible fungi belonging to the fungal sub-division Ascomycotina and Basidiomycotina. These are the eucaryotic, spore bearing organisms, macro-fungi, lacking chlorophyll and grow on dead decomposed matter as saprophytes. They derive nutrients through their mycelia. There are two different types of mushrooms viz. edible mushrooms and poisonous mushrooms.

## Edible mushrooms

Out of almost 2000 identified edible mushroom species, only 20 species are cultivable. Extensively grown edible mushroom are:

- (i) Button mushroom (*Agaricus* spp.), also known as White Button, European Button or Temperate mushroom
- (ii) Paddy straw mushroom (*Volvariella* spp.), also known as Chinese mushroom or Tropical mushroom
- (iii) Oyster Mushroom (*Pleurotus* spp.)
- (iv) Milky mushroom (*Calocybe indica*)

**Out of almost 2000 identified edible mushroom species, only 20 species are cultivable.**

- (v) Shiitake (i.e. Oak tree in Japanese) mushroom (*Lentinus edodes*)

## Species of commercially cultivated mushrooms

- Button Mushroom: *Agaricus bisporus* and *A. bitorquis*.
- Paddy straw mushroom: *Volvariella volvacea*, *V. diplasia* and *V. esculenta*.
- Oyster mushroom: *Pleurotus citrinopileatus*, *P. flabellatus*, *P. florida*, *P. eous* (Pink mushroom), *P. ostreatus*, *P. sapidus* and *P. sajor-caju* (gray oyster).

## Toadstools

Poisonous mushrooms are called as the 'toadstools'. Some of the important examples of poisonous mushrooms are *Amanita phalloides* (The death cap), *A. muscaria* (Fly agaric) and *A. verna* (Destroying angel).

## Others (not extensively grown)

Black ear (*Auricularia auricular*), Giant fungus (*Stropharia rugosa-annulata*), Enokitake (*Flammulina velutipes*), Mitake (*Grifola frondosa*), Jelly fungus (*Tremella fuciformis*), Nameko (*Pholiota nameko*) and Truffle (*Tuber melanosporum*).



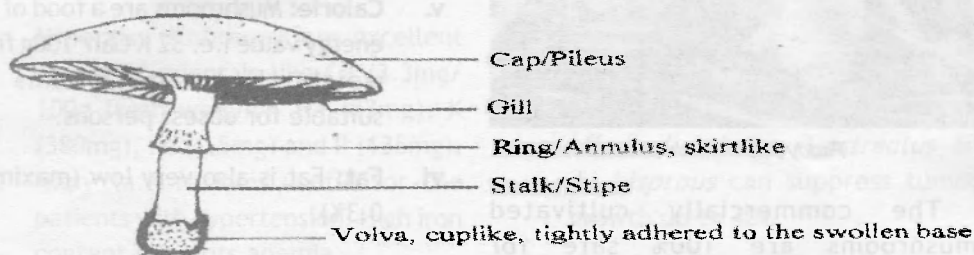
### Morphological features of toadstools and edible mushrooms

Complete identification of toadstool i.e., poisonous mushrooms is a very complex process. It needs a very skillful hand. Every year, on the onset of monsoon, it becomes a common news in regional daily news papers regarding death of quite a good number of people, especially that of tribal community due to consumption of poisonous mushrooms collected from jungle. Some of the morphological features can be considered to distinguish these two groups of mushrooms.

### Poisonous mushrooms

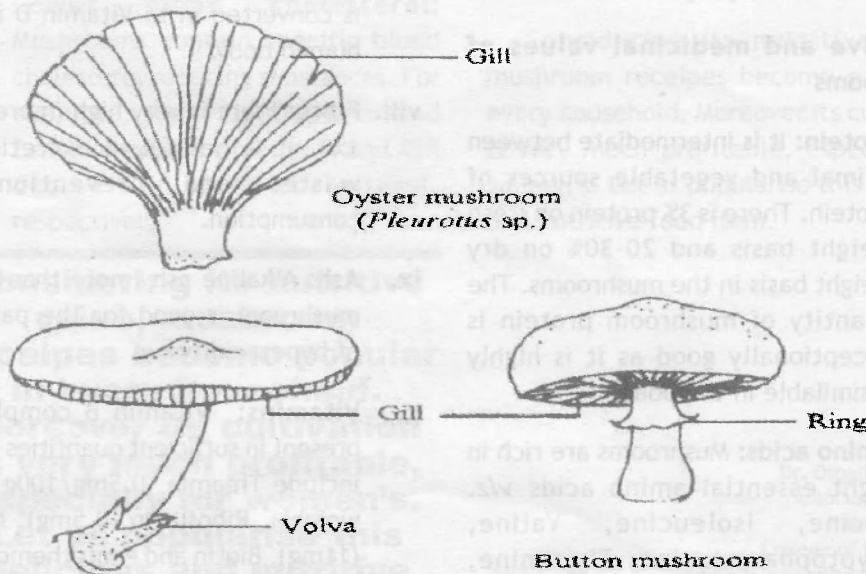
- i. A sac or cup like structure called 'volva' at the base of the stalk/stipe is present (See Figure). It should be observed very carefully to see the skin as it may not be always prominent.
- ii. It has a skirt like ring on the stalk near the cap.
- iii. Gills on the under surface of the cap are white.
- iv. Usually grows up singly or in twos.

#### Deadly poisonous mushroom



*Amanita phalloides* (The Death Cap)

#### Non-poisonous/edible mushroom



Paddy straw mushroom (*Volvariella* sp.)

Button mushroom (*Agaricus* sp.)





Oyster mushroom



Paddy straw mushroom

The commercially cultivated mushrooms are 100% safe for consumption. Only problem comes from mushroom species collected from natural habitats i.e. from jungles

### Nutritive and medicinal values of mushrooms

- i. **Protein:** It is intermediate between animal and vegetable sources of protein. There is 3% protein on fresh weight basis and 20-30% on dry weight basis in the mushrooms. The quantity of mushroom protein is exceptionally good as it is highly assimilable in the body.
- ii. **Amino acids:** Mushrooms are rich in eight essential amino acids viz. Lucine, Isoleucine, Valine, Tryptophan, Lysine, Threonine, Phenylalanine and Methionine which human body cannot synthesize. Cereals, the staple diet of human is deficient in Tryptophan and Lysine. Hence mushrooms can be an ideal supplement to cereal diet. Mushrooms lack two amino acids viz. Methionine and Cysteine. However it can be compensated by cereals.
- iii. **Carbohydrate:** In mushrooms, 4-5% carbohydrate is present. They are mainly chitin, hemicelluloses and glycogen. Starch is absent.
- iv. **Sugar:** There is very little free sugar (0.5%). Hence mushrooms are advised to diabetic patients.
- v. **Calorie:** Mushrooms are a food of low energy value i.e. 32 K Cal/ 100g fresh weight. Hence mushrooms are suitable for obese persons.
- vi. **Fat:** Fat is also very low (maximum 0.3%).
- vii. **Cholesterol:** Cholesterol is totally absent. Hence it is good for heart patients. Ergosterol is present which is converted into Vitamin D in the human body.
- viii. **Fibre:** Fibre is very high (more than 1%). It is helpful in excretion of wastes and prevention of consumption.
- ix. **Ash:** Alkaline ash (more than 1%) of mushroom is good for the patients of hyperacidity.
- x. **Vitamins:** Vitamin B complex is present in sufficient quantities which include Thiamin (0.5mg/100g fresh weight), Riboflavin (0.5mg), Niacin (11mg), Biotin and Pantothenic acid. Vitamin C (4-8mg) and a blood building Vitamin i.e. Folic acid are





Milky mushroom



Button mushroom

also present. Hence it is very useful during pregnancy. Especially in mushroom the Vitamin is not destroyed during cooking, canning or dehydration.

- xi. Minerals:** Mushrooms are excellent source of minerals like Ca (3.3mg/100g fresh weight), Na (83mg), K (380mg), Fe (1.5mg) and P (135mg). High Na:K ratio is useful for the patients with hypertension. High iron content prevents anemia.

#### Therapeutic uses

- a. Lower blood cholesterol:** Mushrooms contain specific blood cholesterol reducing substances. For example, *Agaricus bisporus* and *Lentinus edodes* provide 34 and 45% decrease in blood cholesterol, respectively.

**Considering its nutritive value, mushroom receipes become popular in every household. Moreover its cultivation is very much profitable, especially for women's. Let us popularise this delicious and nutritive food item.**

- b. Hypoglycemic effect:** *Coprinus comatus* has antidiabetic effect. Oyster mushroom is an ideal diet for diabetic and obese persons since carbohydrate and fat are extremely low.

- c. Anti-tumour effect:** Some mushrooms have anti-cancerous effect. *L. edodes*, *P. ostreatus* and *A. bisporus* can suppress tumour growth up to 40%.

- d. Antiviral effect:** A crude extract from Shiitake mushroom can suppress influenza and polio viruses.

Considering its nutritive value, mushroom receipes become popular in every household. Moreover its cultivation is very much profitable, especially for women's. Let us popularise this delicious and nutritive food item.

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# FOSSILS

## - An Introduction

A. Prabhakaran

The term fossil means remains of ancient organisms. It is derived from the latin term "*fossus*", literally meaning "having been dug up". Palaeontologists and archaeologists are very familiar with fossils. Palaeontology is the investigation of life-forms from the distant past, primarily through the study of fossilized plants and animals. The term Palaeontology is derived from the Greek words "*palaios*" (ancient) and "*logos*" (study). In this article the mode of preservation, varieties of fossils and their applications are explained.

### How an organism becomes a fossil ?

There are certain conditions in which the organism can turn into fossils.

- A) Sudden burial of organism after death in lake or oceanic environment.
- B) The organism possess some hard parts.
- C) The rate of sedimentation is adequate.
- D) The area is free from high weathering conditions.

The process of 'fossilization' involves the dissolving and replacement of the original chemical constituents of an organism with other chemical constituents.

The following illustration gives a good overview of the process of fossilization.

**Stage 1 :** Organism dies near the aqueous environment.

**Stage 2 :** Body of the organism is moved

towards any river/lake/ oceanic environment.

**Stage 3 :** Body of the organism is completely covered by overlying sedimentary formations.

**Stage 4 :** Mineralized solution generated from surrounding layers seeps into the pore spaces of organism and precipitate minerals in it and in latter period, it completely transforms the whole organism into fossil.

**Stage 5 :** When water declines, aqueous environment is modified into terrestrial (land) environment.

Generally, geologists follow certain procedures to excavate out the fossils without damage. By erosion of overlying formation, fossils are out-cropped on the surface. Palaeontologists use plaster or tissue paper to prevent the fossil from further breaking. The diagram given below explains the process in a composed manner.

### Different ways of fossilization

There are two main types of fossil preservation: a) with alteration, and b) without alteration. The most common is fossil preservation with alteration; the original organic material is partially or fully changed into new material. There are several types of preservation with alteration as explained below.





## How a fossil is made:

Something dies.



The body is washed into a river or lake.



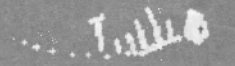
The body lies on the bottom and the flesh rots away.



The skeleton is buried under layers of mud and minerals seep into the bones.



Later the sea level drops and the mud turns to rock.



### Fossil genesis

the original material of the organism is also replaced with mineral. Example: Petrified wood in Satanur, Tamil Nadu.

**C. Recrystallization:** It occurs when a solution or precipitate changes the internal physical structure of a fossil. Recrystallization changes the

**A. Carbonization:** A chemical reaction where water transforms the organic material of plant or animal to a thin film of carbon. Nitrogen, hydrogen, and oxygen are driven off as gases, leaving an outline of the organism. Organisms often preserved by carbonization include fish, leaves and the woody tissues of plants. Example: In India, ancient plant remains from coalfields (Raniganj, Jharia, Neyveli etc.).

**B. Permineralisation and petrification:** The mineralised solution percolates through the pore spaces of organic materials and precipitates minerals in the spaces in the permineralisation whereas, in petrification, while the pore spaces is filled with minerals,

microstructure of the original minerals; they often reform as larger crystals. Example: Many shells originally composed of Calcium carbonate in the form of the mineral Aragonite ( $\text{CaCO}_3$ ) recrystallize into the more stable form of Calcium carbonate called Calcite ( $\text{CaCO}_3$ ).

**D. Replacement:** It involves the complete removal of original hard parts by solution and deposition of a new mineral in its place. The petrified forest in Arizona is an excellent example of this type of preservation. Here the original organic material (wood) has been wholly replaced by Silicic acid.

**Unaltered preservation:** The most common directly preserved fossils are unaltered hard parts of a living organism, like shells, teeth, and bones. In rare circumstances, preservation of the soft parts of an organism may occur. An example is an insect which has become "stuck" in tree resin. When the resin fossilizes to form amber, it preserves the insect.

## How a fossil is found:



The ground erodes away exposing the fossil.



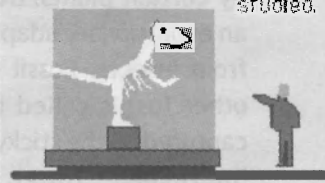
The fossils are photographed then carefully removed.



The fossils are wrapped in tissue paper and plaster bandages for shipment.



With the lab the plaster and rest of the rock is removed and the fossil is mounted or studied.



### Exploration of fossil

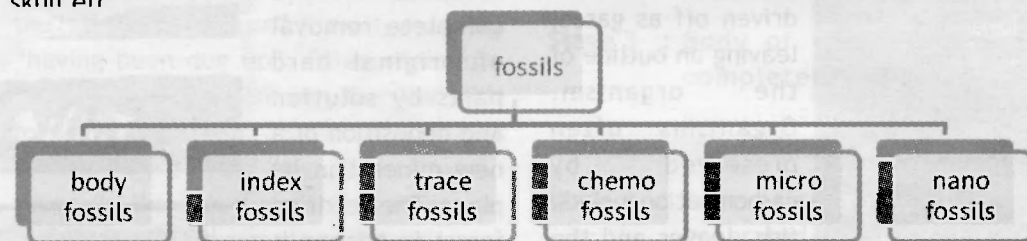
## Kinds of fossils

Based on general nature, fossils are classified into six major categories.

**Body fossils:** A body fossil is a part of (or in some cases the entire) body of the creature. In some rare cases the organic material of the creature remains in the fossil. The best examples are bone, teeth, skull etc



*Insect fossilized by resin*



**Trace fossils:** Trace fossils are fossil traces left by many ancient and extinct organisms. The trace fossils are otherwise called ichnofossils, from the Greek ichno meaning “trace” or “track”. The oldest are from the Twitya Formation in northwestern Canada, dated to 610 million years ago. It offers information regarding activity and physiology of the creature and anatomy. The best examples are tracks, trails etc.

**Chemo fossils:** Ancient organisms leave some biochemical signals, which provide the information to understand the anatomy and evolution of an organism.

**Resin fossils:** Fossil resin is a natural polymer, found in many types of fossilized strata throughout the world, even the Arctic region. The excretion of the resin by certain plants/trees is thought to be an evolutionary adaptation for protection from insects. Fossil resin often contains other fossils called inclusions that were captured by the sticky resin. These include bacteria, fungi, other plants, invertebrates, insects, spiders etc.

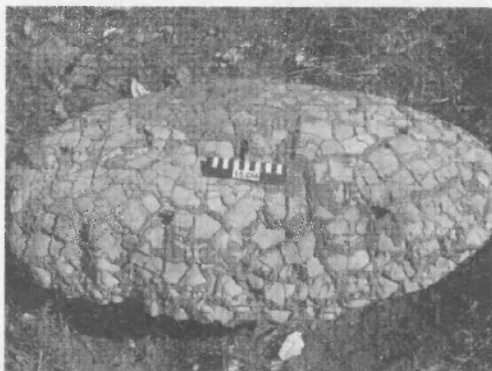
**Living fossils:** It is a general term to convey that a living species have an apparent relationship in morphology/ mode of living to a species previously known from fossils.

**Pseudo fossils:** Pseudo fossils are visual patterns/rock textures in rock layers which are produced by naturally occurring geological processes rather than biological processes. They can easily be mistaken for real fossils. Concretions, spherical or ovoid-shaped nodules found in some sedimentary strata, were once thought to be dinosaurs’ eggs, and are often mistaken for fossils as well.

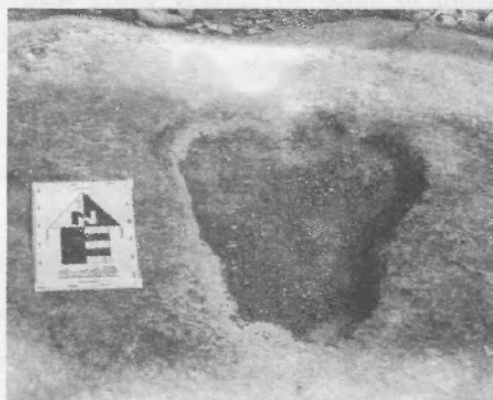
**Micro fossils:** The term applied to fossilized plants and animals whose size is just below the level at which the fossil can be analyzed by the naked eye. The general demarcation line between microfossil and macrofossil is 1mm. Figure below shows some varieties of microfossils.

**Index fossils:** The index fossils generally have very wide geographical distribution but it have very little time span. In





*Concretions are mistakenly identified as Turtle egg shell*

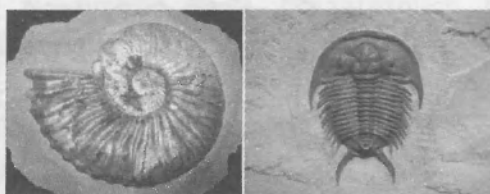


*Dissolution in limestone is misidentified as Dinosaur foot print*

Palaeontology, index fossils are very important to assign age to fossiliferous rock.

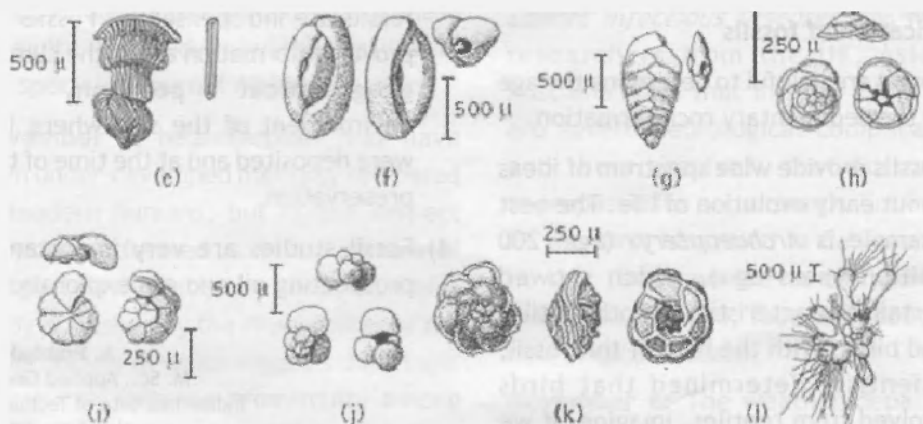
## Facts about fossils

- 1) The time range for fossilization is millions of years.
- 2) Body fossils are comparatively less than the trace fossils.
- 3) All organisms can not change into fossils.



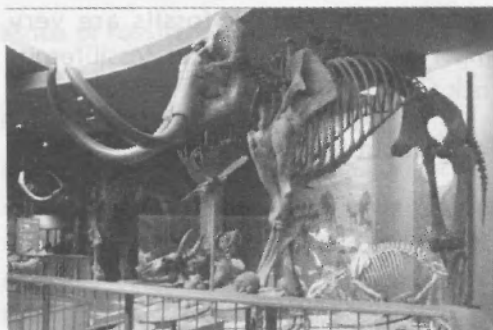
*Ammonites were common during the Mesozoic Era (245 to 65 million years ago (left) while Trilobites were common during the Paleozoic Era (540 to 245 million years ago (right))*

- 4) Fossils are dislodged due to certain significant earth movements.

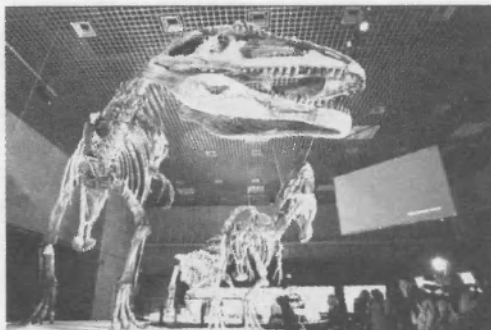


*Above 1mm size - Macrofossil Below 1mm size - Microfossil.*





*Spanish researchers have found that the Woolly Mammoth was driven to extinction by a combination of humans and climate change*



*Dinosaur fossils (age 65 million years ago).*



*Archaeopteryx fossil (age 200 million years ago)*

- 5) Till now, we have an inadequate knowledge about early history of life, because of poor preservation of fossils.
- 6) Most of the fossils are confined to sedimentary rocks.

### **Application of fossils**

- 1) Fossils are helpful to determine the age of the sedimentary rock formation.
- 2) Fossils provide wide spectrum of ideas about early evolution of life. The best example is *Archaeopteryx* (age- 200 million years ago), which showed certain characteristics of both reptiles and birds. With the help of this fossil, Scientists determined that birds evolved from reptiles. Imagine, if we don't know about fossil, we would not have a knowledge about extinct organisms such as dinosaurs, wooly mammoths etc.
- 3) To understand the palaeoclimatology, palaeogeography and palaeoecology fossils are indispensable. Fossils may provide information about the climate, geographical position, and environment of the site where they were deposited and at the time of their preservation.
- 4) Fossil studies are very important in prospecting oil and gas explorations.

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# SCIENCE OF THE MONTH

N.S. Arun Kumar

NOVEMBER 2010

**November 1:** An eight-member Indian team today left from Goa on an expedition to explore climatic changes in the frozen depths of the Antarctic region over the past 1,000 years. The team of Indian scientists is led by Rasik Ravindra, Director of National Centre for Antarctic and Ocean Research, Goa. During their 40-day journey, the scientists will conduct experiments, gather atmospheric data and collect ice cores from the frozen continent in their bid to understand the changes in the environment over past 1,000 years.

**November 2:** A Japanese man has joined the elite club of humans whose genetic code has been fully sequenced, according to research unveiled today. Six other genomes are reported to have been fully sequenced since 2001. They comprise the genomes of James Watson, who co-discovered the structure of DNA; Craig Venter, a US biotech tycoon; a male of the Yoruba ethnicity of western Africa; two Korean males; and a male of Han Chinese ethnicity. The study is published online in the specialist journal *Nature Genetics*.

**November 3:** Neanderthals may have been under-developed mentally compared to modern humans, but in one respect they out-performed us: in the number of sex partners. That's the conclusion of a study published by the *Proceedings of the Royal Society B*, which suggests that finger length can indicate promiscuity among hominins, as the ancient family of humans is known. Researchers from Liverpool

University, looked at fossilised fingers from four hominin species such as *Ardipithecus ramidus*, *Australopithecus afarensis*, Neanderthals and a fossil of an early *Homo sapiens*.

**November 4:** A breakthrough in holographic technology has just brought researchers a step closer to creating real-time 3-D images. Nasser Peyghambarian of the University of Arizona, and colleagues, say their new holographic technology can beam a near 360-degree image that updates every two seconds, to another location. Known as Three-Dimensional Telepresence, the technology addresses shortcomings of current holograms, which give the illusion of 3-D but leave out the rear view. The study appears in the journal *Nature*.

**November 5:** A virus closely related to polio is causing major outbreaks of hand, foot and mouth disease across the Asia-Pacific region. In *Lancet Neurology* and *Lancet Infectious Diseases* this month, researchers from the UK, Asia and Australia warn that in some cases there are severe neurological complications; and there are fears that Australia is unprepared for an outbreak. Enterovirus 71 was first identified in California, US, in the 1960s where it caused small outbreaks of hand, foot and mouth and neurological disease.

**November 6:** The weather department has warned of the cyclone called Jal that is likely to hit the northern region of Tamil

Nadu and southern region of Andhra Pradesh coasts, India by Sunday evening. Cyclone Jal is currently in one of the neighbouring countries of India, Sri Lanka. The department informs that there is a huge possibility of heavy rainfall in the coastal regions of Tamil Nadu, Pondicherry (Puducherry) and Andhra Pradesh anytime, within 24 hours (It later weakened and claimed only 11 lives in different incidents).

**November 7:** NASA's human spaceflight programme might take some giant leaps forward if the agency embraces genetic engineering techniques more fully, according to genomics pioneer J. Craig Venter. Craig Venter who is a pioneer in creating "artificial life" said that human space exploration could benefit from more genetic screening and genetic engineering. Venter was speaking to a group of scientists and engineers who gathered at NASA's Ames Research Center for two different meetings: a synthetic biology workshop, organised by NASA.

**November 8:** Stem cell researchers have found a way to turn a person's skin into blood, a process that could be used to treat cancer and other ailments. The method uses cells from a patch of a person's skin and transforms it into blood that is a genetic match, without using human embryonic stem cells, said the study in the journal *Nature*. With the ability to create blood for transfusion from a person's own skin, the advance means someday patients needing blood for surgery could bypass the blood bank and derive the necessary supply from themselves.

**November 9:** Physicists working on the ALICE experiment in the Large Hadron

Collider (LHC) at the European Organization for Nuclear Research (CERN) have started smashing heavy lead ions together at close to the speed of light - in the process recreating the universe as it was 13.7 billion years ago. The successful collision of lead ions in the accelerator at record energies allows matter to be probed as it would have been in the first moments of the Universe's existence. This comes after seven months of successfully colliding hydrogen proton packets at high energies.

**November 10:** Scientists in China have bred the country's first genetically engineered Rhesus monkey, a step that could speed up the development of cures for diseases ranging from cancer to Alzheimer's. Scientists used green fluorescent protein (GFP), a substance originally isolated from a jellyfish and now commonly used as a biotech marker, and implanted transgenic embryos in the uteri of surrogate mother monkeys, said Ji Weizhi, a researcher with the Kunming Institute of Zoology under the Chinese Academy of Sciences.

**November 11:** A new study has resolved the age-old issue of the origins of the people who introduced farming to Europe some 8000 years ago. A detailed genetic study by an international team of researchers led by ancient DNA experts from the University of Adelaide revealed marked similarities with populations living in the Ancient Near East (modern-day Turkey, Iraq and other countries) rather than those from Europe. The results of the study were published in the journal *PLoS Biology*.

**November 12:** Fifty-eight years after sponsoring Kalinga Prize established by





UNESCO for popularization of science globally, Kalinga Foundation Trust (KFT) today announced introduction of 'Kalinga Samman' for the scientists from Orissa. Some of the great scientists/personalities who have been awarded Kalinga Prize are Louis de Brogile (1952), Julian Huxley (1953), George Gamow (1956), Bertrand Russel (1957), Arthur C. Clarke (1961), Fred Hoyle (1967), Sergei Kapitza (1979) and Prof. Yash Pal (2009).

**November 13:** The Himachal Pradesh government has taken an initiative to preserve 'Chamurthi', one of four recognized indigenous horse breeds in India. 'Chamurthi', or snow horse, is an endangered species, which has prompted the government to initiate a preservation project. It is one of the most popular breeds of horses in the world. They are very strong, sure-footed, rarely fall sick, and have great endurance. The 'Chamurthi' horse traces its origin to the Tibet region.

**November 14:** Archaeologists in New Mexico have discovered what they believe is a complete mammoth skeleton. The New Mexico Natural History Museum Foundation will hold a special event at the Western Heritage Museum next week during which Executive Director Calvin Smith will announce the historic find. So far, amateur archaeologists have unearthed a femur, tibia, fibula and a carpal. Smith has found the remains of five mammoths in Lea County, but this could be the first complete skeleton.

**November 15:** Today is the Steve Irwin Day. Australia Zoo on Queensland's Sunshine Coast will celebrate the life and legacy of Steve Irwin who died after he was stabbed in the heart by a stingray barb while filming a nature documentary off

far north Queensland's coast on September 4, 2006. It was his widow Terri and family decided the year Irwin died to make the anniversary of the 44-year-old's death a private day and established November 15 as Steve Irwin Day for the public. Link: <http://www.steveirwinday.org/>

**November 16:** Wayanad Jeerakasala Rice, Wayanad Gandhakasala Rice and Central Travancore Jaggery have been registered with the Geographical Indications (GI) registry at the initiative of the Kerala Agricultural University. Geographical Indications identify products, the reputation or other characteristics of which are essentially attributable to its geographical origin. The registration is intended to prevent unauthorised use of a registered geographical indication by others and to promote economic prosperity of its producers.

**November 17:** In a bid to solve Earth's energy woes, scientists are contemplating building the world's first "sustainable fusion" reactor by creating what they claim a miniature star on our planet. Following a series of key experiments over the last few weeks, the 2.2-billion-pound project has inched a little closer to its goal of igniting a fusion reaction by 2012. National Ignition Facility in Livermore, has earlier fired up the LASER-experiment resulting release of energy of a magnitude of 1.3 million mega joules, which was a world record.

**November 18:** A large new species of deep red, glowing squid has been discovered living near under-sea mountains in the southern Indian Ocean. At about 28 inches (70 centimeters) long, the yet unnamed species is relatively big—though other

squid can reach as long as 65 feet (20 meters), some species are barely three quarters of an inch (1.5 centimeters). The new species belongs to Chiroteuthidae, a group of slender squid in which light-producing organs run in the family.

**November 19:** Physicists have succeeded for the first time in trapping atoms of anti-hydrogen, a feat that could take researchers one step closer to understanding anti-matter. That, in turn, could reveal all sorts of things about gravity and perhaps shed light on what happened to all the antimatter that theoretically should be, but isn't, present in the universe. Two groups have been working on trapping anti-hydrogen at the European Organization for Nuclear Research (CERN) in Geneva, Switzerland.

**November 20:** Around four lakh species of plants and animals in the country are yet to be identified, as many biodiversity-rich areas remain inaccessible, said M. Sanjappa, Director of Botanical Survey of India. About 33 per cent of the higher plant species are endemic. There are 17, 588 species of Angiosperms, of which 5,725 are endemic. The three megacentres of endemism are Western Ghats, Eastern Himalayas and Western Himalayas. There are 3,000 medicinal species, of which 85 per cent are wild.

**November 21:** In an attempt to answer Astrobiology's fundamental questions about the origin, evolution, and distribution of life in the universe, NASA launched a nanosatellite, known as Organism/Organic Exposure to Orbital Stresses, or O/OREOS. NASA also launched its Fast, Affordable, Science and Technology Satellite, or FASTSAT. It is a unique platform creating opportunities for

researchers to conduct low-cost scientific and technology research on an autonomous satellite in space.

**November 22:** Scientists have discovered the first planet from another galaxy. It has been discovered orbiting a star called HIP 13044, located about 2,000 light year away. The new planet is orbiting a star from what is known as the Helmi stream – a group of stars that originally belonged to another galaxy that was captured by our Milky Way about six to nine billion years ago. The new planet is about 20 percent larger than Jupiter. A telescope in Chile was used to make the discovery, the journal *Science Report* says.

**November 23:** Researchers in Norway and France have deciphered the genetic blueprints of a tunicate called *Oikopleura dioica*, a tiny member of one of the most abundant plankton types in the oceans. The animal's compact genome contains roughly 18,000 genes - nearly as many as the human genome's 22,000 or so, but with genes in a completely different order and less DNA stuffed in between them, the researchers report in the journal *Science*.

**November 24:** Scientists at sites in eastern Utah say they have discovered two new species of dinosaurs related to the plant-eating, beaked Iguanodon. Teams led by the Utah Geological Survey discovered the bones in 2004 and took years to extract them. Paleontologist Jim Kirkland says the specimen dubbed "Iguanacolossus" includes most of the backbone, tail, ribs, hip and shoulder. Iguanodons were able to walk on their hind legs. The species were identified in online scientific journal *PLoS ONE*.



**November 25:** DNA experts are working with sweet giants Mars to create genetically modified chocolate that fights heart disease and diabetes and won't make you fat. The beans contain chemicals called flavonols which lower blood pressure and help keep the heart healthy. And the scientists believe they can change the DNA of the cocoa tree so it produces beans with far higher levels of flavonols. They also hope to produce beans that fight diabetes, as well as making the fat in cocoa much healthier.

**November 26:** Four clones of Dolly the sheep, the world's first mammal to be cloned from an adult cell, are alive and well and living in Nottinghamshire. University of Nottingham researchers created the quads three-and-a-half years ago from the same genetic material used to make Dolly. The sheep are being used to carry out further research into cloned animals' longevity and susceptibility to disease. Professor Keith Campbell, leading the research into animal development, was part of the team that created Dolly.

**November 27:** An advanced communication satellite HYLAS (Highly Adaptable Satellite), built by ISRO on a commercial basis in partnership with EADS-Astrium of Europe, was successfully launched today by the European Ariane-5 V198 launch vehicle from the Guyana Space Centre at Kourou in French Guyana. HYLAS satellite developed for Avanti Communications, UK consists of ten high power transponders that use eight in Ka and two in Ku band frequencies.

**November 28:** Saturn's second-largest moon Rhea has a wispy atmosphere with lots of oxygen and Carbon dioxide, a new

study has found. Oxygen atmospheres are known to exist on other natural satellites in solar system. For example, Europa and Ganymede, moons of Jupiter, are also rich in oxygen. But the discovery on Rhea suggests that many other large, ice-covered bodies throughout the solar system and beyond may harbor thin shells of oxygen-rich air and, perhaps, complex chemistry, researchers said.

**November 29:** Representatives of the United Nations Framework Convention on Climate Change (UNFCCC) signatory countries gathered today in Cancun, Mexico for a summit to draw out a plan to curb global warming. At the summit, which will run until December 10, the leaders of the world's 20 major economies will attempt to reach a binding agreement on curbing greenhouse gasses after 2012, when current emission reduction targets laid out in the Kyoto Protocol expire.

**November 30:** Tripura has huge stock of 'unexplored' Anthracite coal, considered as black gold. A team of Geological Survey of India (GSI) has been conducting survey extensively in different villages of Tulashikar block in Khowai subdivision over the past few days. This is for the first time, the GSI has undertaken exploration drive for coal and it got success. If the test gives positive report, the economy of not only Khowai subdivision but also the State will get a massive boost.

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# ON SOME CRUCIAL S&T ISSUES IN CONTEMPORARY INDIA: Some Thoughts

Dr. A.D. Damodaran

The last Issue had concluded with the following: "What those newly imposed pressures were and how serious they were, the public could at least quasi-authoritatively come to know only through the monograph "Engaging India - Diplomacy, Democracy and the Bomb" by Strobe Talbot in 2004. Seeing that the embargo related supply restrictions imposed on India through the Nuclear Suppliers' Group, itself formed at the initiatives of the West essentially after the Pokran I, only delayed DAE's programmes, the post-Pokran II measures were planned more vigorously as expected from the emerging geopolitics. Fresh attempts were made to make it sign NPT which for many in India embodied "the three D's" of the US nuclear policy dominance -

dominance, discrimination and double standards", to quote Talbot himself!"

Before going further into such details from Talbot's book, it is important to remind ourselves once again what the pressures on India were in the nineties from the superpowers. To quote from the well-referred book "India after Gandhi" by Ramachandra Guha, "During the 1990s Indian politics became more complex at the domestic level ....However when it came to India's dealings with the rest of the world; there was a noticeable convergence of views. ...India was rapidly moving from a 'defense dependent upon diplomacy to a diplomacy strengthened by a strong defense' ....In addition to the Agni and Prithvi missiles developed in the 1980s, India now had an intercontinental ballistic missile, Surya (with a range of up to 12,000 kilometers), and another Sagarika, that could be launched from sea...and shorter-range missiles to be aimed at the enemy might throw at them. The missiles were designed by DRDO... the other was the Atomic Energy Commission which had the responsibility for the production of both nuclear power and nuclear weapons. An atomic device had been tested in 1974, but in subsequent years the AEC scientists were able to improve considerably in sophistication and destructive capability. From the early 1990s

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they pressed the government to allow them to test their improved bombs.

"In his history of India's nuclear programme, George Perkovich tracks the persistent efforts of the scientists. Those who led the missile and nuclear programmes told successive Prime Ministers that, in the absence of tangible results, talented young scientists would prefer high-paying jobs in the commercial sector to the service of the state. 'Without full-scale tests', they argued, 'morale would fall and the nation would not find replacements for the aging cohort that had produced the first device in 1974'. In late 1995 Prime Minister Narasimha Rao sanctioned tests, but backed off when American satellites revealed the preparations, provoking a strong warning from the US government..."

"The BJP-led NDA assumed office in March 1998. The next month Pakistan tested a medium-range missile, provocatively named Ghaury, after a medieval Muslim warrior who had conquered and (according to legend) laid waste to much of northern India. A quick response was called for, if only because 'the BJP's historic toughness on national security would have seemed hollow if the government did not respond decisively to the new Pakistani threat'. The heads of AEC and the DRDO insisted that a nuclear test would be the most fitting response. Their calls were endorsed by the atomic physicist Raja Ramanna, who carried enormous prestige as the man who had 'fathered' the 1974 tests. Ramanna met the Prime Minister Vajpayee, who assured him that he wanted 'to see India as a strong country and not as a soft one'. To this the physicist added a definitive caveat: 'Also, you can't keep scientists

in suspended animation for 24 years. They will simply vanish. In the second week of May 1998 the Indians blasted five nuclear devices in the Rajasthan desert.....Indian leaders demanded that in deference to its size, democratic history and economic potential, the country be made a permanent member of the UNSC. That the claim was disregarded made the matter of nuclear tests all the more urgent. Across party lines, strategic thinkers argued that an open declaration of nuclear weapons would make the Western powers sit up and take notice. Reason and argument having failed, India had necessarily to blast its way to world opinion".

Not unexpectedly, the DAE was entering this time a more powerful Chakravayoocha, and that too of a totally different dimension as well as would become clear soon! Whatever were the points expressed by our PM claimed in justification for Pokran II, the West and specifically the US did not take India to 'blast its way to the world opinion' with any favor; instead US immediately appointed a powerful commission headed by a former Vice Chairman of the Joint Chiefs of Staff himself to investigate. The report highlighted three factors: India's success in keeping the preparations secret, its use of diplomacy to lower suspicions of an imminent test (which the State Department spokesman Jamie Rubin called a 'a campaign of duplicity') and the relatively low priority that Washington assigned to South Asia. "We are going to come down on those guys like a ton of bricks" said President Clinton as he opened a meeting in the Oval office, to quote Talbot. Systematic steps were unleashed to encourage and coordinate condemnations of India by other countries and international bodies. An array of

sanctions was cranked against India including a halt in defense sales, export licenses for munitions, denial of government credits and loan guarantees, obstructions for loans from WB and IMF, termination of most assistance programmes, review of scientific programmes and even denial/withdrawal of visas of Indian scientists. Its Chairman of the Senate Foreign Relations committee went much further, thundering that India now "clearly constituted an emerging nuclear threat to the territory of the United States". President Clinton said, "My mistake was not cozying up to India a lot earlier so that we might have had some leverage over those guys before they hit the button on that bomb". Patrick Moynihan said that the US should welcome India into the ranks of nuclear weapon states, in exchange for its willingness to sign CTBT - which would be proof of its being a "responsible grown-up in these matters"! It was argued that in theory CTBT is after all, unlike NPT, not an unequal treaty, not discriminatory and hence could as well be acceptable to India!

The new strategy of 'containing India' was repeated in another speech by President Clinton in CNN a few days later thus, "I hope the Indian government soon will realize that it can be a very great country in the 21<sup>st</sup> century without doing things like this ....But to think that you have to manifest your greatness by behavior that recalls the very worst events of the 20<sup>th</sup> century on the edge of the 21<sup>st</sup> century, when everybody else is trying to leave the nuclear age behind, is just wrong. ....I think that all of us have a responsibility to say that, and to say that their best days are ahead of them, but they can't - they have to define the

greatness of India in the 21<sup>st</sup> century, not in terms that everybody else has already decided to reject".

The situation in India itself was mixed. While the 'hardliners' in the ruling NDA combine wanted the government, come what may, to withstand the possible sanctions, the Prime Minister chose to adopt a softer path. He, in the words of Talbott, decided "to reach out to the Clinton's administration....and (work for a) more equitable relationship" through his advisor Jaswant Singh. Surprisingly enough, there were not many serious responses either way from the opposition parties except that the general consensus was against India accepting any pro-NPT stand, the same being accepted as totally discriminatory. In a way this was the beginning of the US 'engaging' India in such a way that it may 'never do it again' - that is, ... accept a permanent prohibition on further testing, preferably by joining the CTBT and also cooperate with the United States and other countries in bringing to a rapid conclusion a negotiation that had been going on fitfully for three years on a treaty that would end the production of fissile material (weapons-grade plutonium and highly enriched

**Another was to refrain from putting nuclear warheads on their bombers or missiles ...and the third was not to export equipment, materials or technology that could help other countries acquire nuclear weapons or ballistic missiles of their own", in essence, make India implement the provisions of NPT.**

**That means the US government should persist until the four areas of restraint become the basic Indian policy.....Indians wanted – and still want – total acceptance as a nuclear power without having to accept any meaningful restrictions on their programmes...**

uranium). Another was to refrain from putting nuclear warheads on their bombers or missiles ...and the third was not to export equipment, materials or technology that could help other countries acquire nuclear weapons or ballistic missiles of their own", in essence, make India implement

the provisions of NPT. India on the other hand maintained its stand, in the words of Jaswant Singh "If we have the kind of neighborhood that India has, which is extremely troubled, and if we have two declared nuclear weapon powers in our neighborhood, the basic requirement is to acquire a balancing deterrent capability". According to India it had only corrected a clear-cut "disequilibrium" in the Asian nuclear balance.

Between these two differing points of view, discussions were systematically held between the US and India at various levels (Talbot's book may be referred for details) and finally the US under the Clinton regime formulated a concrete policy doctrine for the US in terms of pushing India alter its policies tailored within the following four non-proliferation benchmarks. In the words of Talbot himself, "If there is a deal to be done with India, my guess is that it will be a version of the one offered by the Clinton

administration and rejected by the BJP-led government. The four US-proposed non-proliferation benchmarks put forward in 1998 - joining the CTBT, making progress on a fissile materials treaty, exercising strategic restraint (by that or some other name) and meeting the highest standard of export controls - took account of India's accomplishments and aspirations, its rights and anxieties, its opportunities and obligations, and the dangers that its nuclear test was meant to deter as well as those that the test created or exacerbated....The benchmarks, in substance, even if not so designated, should remain the basis of American policy in the future. That means the US government should persist until the four areas of restraint become the basic Indian policy.....Indians wanted - and still want - total acceptance as a nuclear power without having to accept any meaningful restrictions on their programmes... As for its end of the bargain, the United States - in addition to considering India for a place on an expanded or reconstituted Security Council - might permit the government in New Delhi to receive some of the international help it seeks in developing its civilian nuclear power and its commercial space-launch capacities and to benefit from a relaxation of ...legal restrictions ...with regard to India's desire for high-technology items from the United States".

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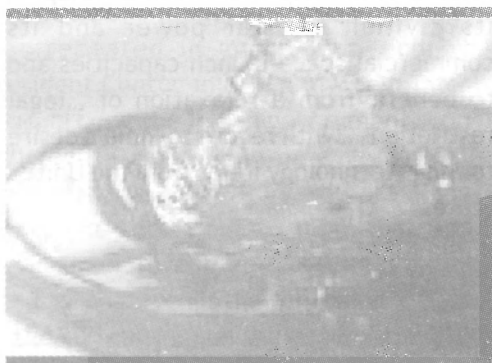
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# SUGARCANE, SO SWEET OF IT

Dr. K. Chandran

Sugar has become an inevitable component in the food cycle of present day people and the rate of consumption of sugar has increased tremendously in the immediate past. Though it is not a primary food item, it is not possible to imagine life without sugar as on today. However, it is interesting to note that none of the holly literature had the reference of sugar and all civilization of the past lived without sugar. The first sweetening material used by our ancestors was Honey. Sugar was a rare commodity in Europe until the Middle Ages and was available to only Aristocratic society and sold in medical shops. By the end of 15<sup>th</sup> century sugar had replaced honey as a sweetener and became cheap and a common food for all by the 19<sup>th</sup> century.



Honey

## History of sugarcane

All green plants are capable of synthesizing sugars through photosynthesis but the accumulation rate

vary with the plants. Sugarcane is the most efficient converter of solar energy, CO<sub>2</sub> and water into sugar. Besides sugarcane, other plants viz., sugarbeet, carrot, maize, sorghum, sugar maple and several palms are capable of storing sugar. The world's major sugar supply comes from culms of sugarcane. Sugarcane originated in south pacific islands and spread throughout South East Asia. It is known to have been cultivated from pre-historic times. During the invasion of India by Alexander's Army in 327 BC, they found that local people obtain sweet material from reeds. Columbus is credited for introducing sugarcane into the New World. The name sugar is derived from the Sanskrit Word 'Sarkara' meaning gravel or sand. The original name was changed during the journey to Sukkar in Arabic, Sakharon in Greek, Sucre in French and finally Sugar in England.

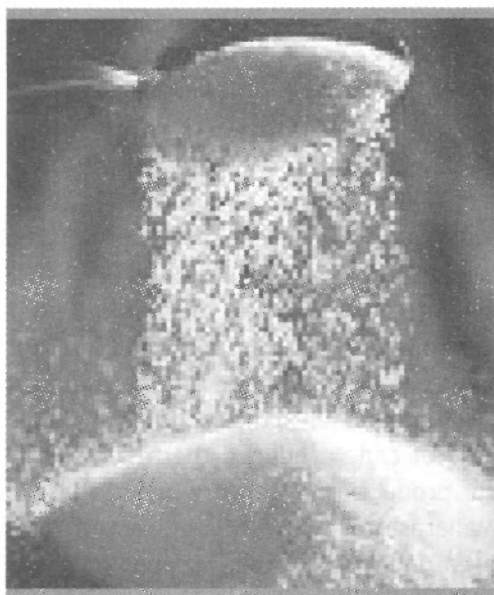
The history of the Indian sugar production has witnessed two major events, one is the introduction of thick and juicy noble canes (*Saccharum officinarum*) and the second, development of man made hybrid in early 20<sup>th</sup> Century. Now India is the second largest producer of sugarcane, besides Brazil.

## Sugar consumption

Along with increase in production, the per capita consumption of sugar also went





*Commercial Sugar*

on increasing. The increase in consumption is closely associated with industrialization, increased personal income, and ease of availability of processed foods, beverages and soft drinks. The highest consumption is reported from Netherlands; 142kg/annum followed by Switzerland 73.5kg/annum. Generally consumption is more in the producing countries like Brazil, Cuba, Australia where it exceeds 50kg/annum. The industrialized western countries are in second position with consumption ranging from 30 to 40kg. In countries like China it is as low as 9kg and still low in economically poor countries of Africa. In India the average per capita consumption of total sugar is 20.8kg/annum during 2006-07 (Table 1) and the consumption of total sugar is not increased but consumption of white sugar has increased tremendously from 4.8kg/annum during 1960s to 17.8kg/annum by 2005-06. However consumption of Gur and Khandasari has been reduced from 15.2 kg/annum to 3kg/annum. The highest per capita consumption in India are recorded

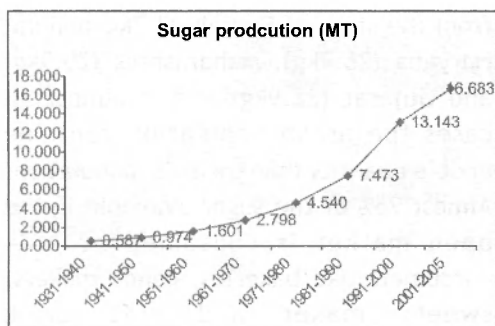
from the state of Punjab 33.7kg/annum, Haryana (26.9kg), Maharashtra (25.9kg) and Gujarat (22.9kg) and in almost all cases the urban population consume double quantity than the rural population. Almost 75% of the sugar available in the open market is consumed by bulk consumers like bakeries, candy makers, sweets maker and soft drink manufacturers. Khandsari sugar is less refined and is typically consumed by sweet makers. Gur, an unrefined form of lumpy brown sugar, is mostly consumed in rural areas.

Table 1. Per capita consumption of sugar in India (Source 'Cooperative Sugar')

Year	Per capita consumption (Kg/annum)		
	Sugar	Gur & Khandasari	Total
1960-61	4.8	15.2	20.0
1970-71	6.8	12.5	19.3
1980-81	7.3	12.5	19.8
1990-91	12.9	10.9	23.8
2000-01	15.8	8.4	24.2
2001-02	16.1	8.0	24.1
2002-03	16.4	5.4	21.8
2003-04	16.3	6.6	22.9
2004-05	16.7	7.5	24.2
2005-06	17.0	5.2	22.2
2006-07	17.8	3.0	20.8

### Trends in production

Our sugar production was a meager 1.1 million tonnes in 1950-51 and it increased to 19.2 million tonnes in 2005-2006, an increase of 17.5 times in 55 years. This was obtained with 5.1 times increase in sugarcane production from 54.8 million tonnes to 281.1 million tonnes in that period and the remaining part by increasing the quality and primarily sugar content. The increase in sugar production over decades since 1930's is shown in Figure. Nearly 14 per cent of the world sugar production is from India. We have more sugar produced than that required



*Trends in sugar production*

for internal consumption with more than 11.02 lakh tonnes available for export during 2005-06.

The productivity of sugarcane improved in almost all the sugarcane growing regions in this country in the recent years and the spread of improved hybrid sugarcane varieties was very rapid. Demand for sweeteners is increasing year after year and sugar, jaggery and khandasari are made out of sugarcane. The alternate uses of sugarcane for ethanol as motor fuel, bagasse for paper production or for co-generation of electricity and molasses for ethanol as well as industrial chemicals will add to the importance of sugarcane.

Sugarcane is commercially grown in all agro-climatic regions of the country except in the hilly areas of Jammu and Kashmir and Himachal Pradesh. In the



*Sugarcane crop*

fifties nearly 80 per cent of the sugarcane area was confined to the northern states of Uttar Pradesh, Bihar, Haryana and Punjab. With increase in irrigation facilities and other developmental activities, large areas in Maharashtra, Karnataka, Tamil Nadu and Gujarat were brought under sugarcane cultivation in the seventies and eighties. At present 51 per cent of the total sugarcane area is in Uttar Pradesh, having 31 per cent of the total sugar production in the country and a large part of cane produced there is diverted for production of jaggery or khandasari. Maharashtra, with 11.9 per cent of total area under sugarcane, account for more than 26.9 per cent of total sugar produced (Table 2). The increase in sugar cane yield and sugar recovery in Maharashtra, Tamil Nadu and Karnataka in the recent years is worth mentioning, where the increase in area under cultivation, better management practices and irrigation facilities resulted in the production and productivity at very high level.

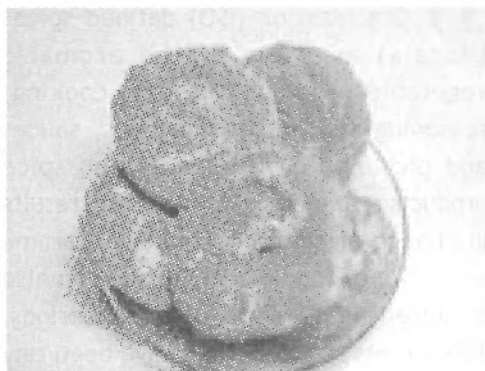
### **Sugarcane as a multi-purpose crop**

Most of the sugarcane produced in the country is used for production of sugar or other sweeteners such as jaggery and khandasari. About 70% goes for production of white sugar, 12% for seeds, feed and chewing and 19% for Gur khandasari. Sugarcane is consumed by chewing and cane juice is a refreshing and nutritive drink. The sugarcane green top is good as fodder to milch animals and is added to silage to improve its palatability. The molasses is used for production of ethanol and industrial chemicals. The bagasse is good for paper production and as fuel for the boilers in the factory. Oflate bagasse is used for co-generation of electricity and the extra electricity generated is being

Table 2. Sugarcane and sugar production in major sugarcane growing states in India in 2005-06 (Source: Sugar India).

State	Crop Area (1000 ha)	Sugarcane Production (Lakh tonnes)	Productivity (t/ha)	Sugar Production (Lakh tonnes)
Uttar Pradesh	2156	1255	58.2	59.54
Maharashtra	501	388	77.6	51.97
Tamil Nadu	336	351	104.7	21.70
Andhra Pradesh	230	176	76.8	12.36
Karnataka	219	182	83.4	19.43
Gujarat	197	146	74.0	0.18
Haryana	127	82	64.4	11.68
Bihar	101	43	42.8	4.22
Uttaranchal	101	61	60.7	4.26
Punjab	84	49	57.9	3.38
Madhya Pradesh	56	24	43.7	0.94
All India	4201	2811	66.9	192.67

supplied to the power grid. The ethanol produced from sugarcane is widely used as motor fuel or additive to petrol in Brazil and USA. More than half of the cane produced in Brazil, which is the largest sugarcane producing country, is used for ethanol production. As an oxygenate, ethanol ensures a more thorough, qualitatively better and quicker combustion of petrol. The atmospheric pollutants including hydrocarbons, Carbon monoxide, Nitrous oxide, fine particles etc. are reduced in the emission when ethanol is blended with petrol. Measures were initiated in India also to use ethanol as an additive to petrol and ethanol blended petrol will be available soon as motor fuel. As a renewable source of energy and being less pollutant, ethanol from sugarcane will help in reducing dependence on imported petroleum products. The addition of 5 per cent ethanol to petrol can save up to ₹ 3,000 crores annually in foreign exchange. Besides its commercial importance, it is being widely used for medicinal purpose. Sugarcane is reported to be an antidote, antiseptic, bactericide, cardi tonic, demulcent, diuretic, intoxicant, laxative,

*Jaggery*

pectoral, piscicide, refrigerant, and stomachic. It is a folk remedy for arthritis, bed sores, boils, cancer, colds, cough, diarrhoea, dysentery, fever, hiccups, inflammation, laryngitis, opacity, skin sores, sore throat, tumors, and wounds. The sweetness of sugarcane is not only restricted to sugar production alone but extend to fibre, fuel and for therapeutic use and in the strict sense can be called as a multipurpose crop of immense importance to a developing nation.

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# **Importance of spices with special reference to Kala Zeera – An unexploited spice**

**Dr. Javid Iqbal Mir and Prof. Nazeer Ahmed**

**W**ebster and International Standard Organization (ISO) defined spices (Masala) as, "Any of the aromatic vegetable products" used in cooking, seasoning and preserving foods, sauces and pickles etc. The spices and spice products after adding in foods, etc. results in change of colour, appearance, aroma and taste of food materials and can also be stored in fresh state for longer periods. The secrets of great chefs have been tiny amounts of unusual flavorings added in unrecognizable quantity to change the taste and flavour of foods. They are used for flavoring beverages, pickles, sweets and other delicacies. They enhance or vary flavors of the food, also taste disguisers, mask the taste of tainted foods and thus play a great role to brighten the otherwise dull diet. In most developed and developing countries, spicy food has become the rule of the day and a trend of ready to eat and specialty cuisine is

emerging in the food industry where spice play a significant role. The role of spices in social, cultural and economic evolution of India is well known being used in the family at all occasions in one or the other forms for culinary purposes. Some of them also possess antioxidant properties while others are used as preservatives in some food items like chutneys and pickles. Some spices also possess strong anti-microbial and antibiotic activities. Many of them have medicinal properties and have profound effect on human health as they affect many functional process like intensification of salivary flow and secretion of amylases, neuraminic acid, and hexosamines. They favor the cleaning of oral cavity from food adhesion and bacteria. They may help check infection and chemical irritation. Spices increase the secretion of saliva rich in ptyalin which facilitates starch digestion. Spices possibly activate the Adreno cortical function and

**Some spices also possess strong anti-microbial and antibiotic activities. Many of them have medicinal properties and have profound effect on human health as they affect many functional process like intensification of salivary flow and secretion of amylases, neuraminic acid, and hexosamines.**





fortify resistance and physical capacity stroke volume, blood pressure and stroke frequency can be markedly diminished and augmented with the help of spices. They inhibit thrombus formation and accelerate thrombolysis. They are also used as physical and chyrugucal remedies and used to cure the distempers, wounds and sores of the patient's sea sickness and scurvy. They stimulate digestion on account of their carminative properties and also known as appetizers. Commercial bakers, pickle packers, condiment manufacturers and canning industry as a whole becomes other important users. Spices are also used in pharmaceutical and cosmetics besides being used in confectionary, soap making and making of incense. They entertain the gardeners as well as the people who visit the garden. Sweet smelling spices and herbs make the garden nice with their lovely scent and make the evening stroll a fragrant and agreeable pleasure. They furnish the garden with their beauty and beautify the living conditions of the gardeners. The essential oils and oleoresins derived from spices are used in perfumery and toilet goods.

The spices are the outcome of various plant parts. Cloves and saffron are the floral parts, turmeric and ginger are rhizomes, angelic, lovage and horse radish are roots, cinnamon and cassia are bark, chilies and cardamom are fruits/pods/capsules, while coriander, cumin, kala zeera, fennel etc. are seeds.

Spices contribute to the Indian economy through export, are suitable for intercropping, mixed cropping and multistoried cropping, are cash crops for small and marginal farmers and as raw

material for many industries. There is a considerable volume of international trade in spices in India being one of the major spice producing and exporting countries. India alone contributes 25-30% of total world trade in spices. Spices exports have registered a substantial growth during the last one decade. During the year 2002-03 the spices export has touched an all time high of 2641,107 metric tonnes. However, during 2003-04 the export declined to 245,382 MT value worth ₹ 191,160 lakhs. The decline was mainly due to decline in export of mint products and also because of low volume of pepper export coupled with low unit value realization. The major items of exports (volume-wise) from India (2003-04) are chillies (34%), turmeric (15%), coriander (8%) and pepper (7%). The major destinations of Indian spice exports is USA followed by EU, Sri Lanka, Japan and Middle East countries. The export thus earns foreign exchange for use for development and progress of the country. India as it is called the country of spices, or home of spices, produces more than 5.11 million MT of spices in an area of about 5.15 million hectares. Of the 107 spices listed by the International Standard Organization (ISO 676), India grows about 52 spices as per their suitability in different agro climatic conditions and congenial situations. At present only 16 spices are considered as commercially important such as cardamom, ginger, black pepper, turmeric, clove, chilli, garlic, saffron, Kala zeera, celery, cumin, coriander, fennel, fenugreek, ajwain and suwa which are classified as seed spices. The seed spices are mainly cultivated in Rajasthan and Gujarat with a sizable area in M.P. Haryana, Punjab, U.P, A.P. and

Bihar. The hilly temperate areas of the country have comparatively low temperatures in winter and moderate temperatures in summer, so the seed spices produced in these areas are comparatively of superior quality. Cumin, coriander, kala zeera, fennel and fenugreek are the seed spices which are grown in temperate regions.

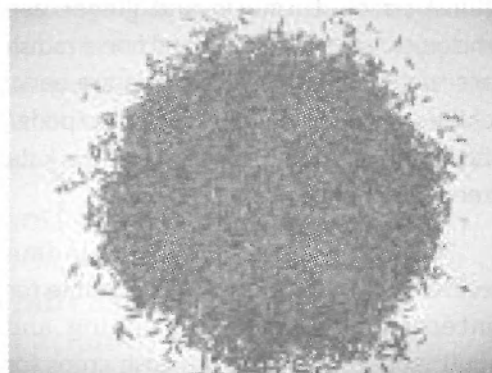
Among the major spices, mustard seed occupies the largest area sharing about 57.9% of the area under spices, followed by chilli, cumin and coriander sharing about 16.18, 10.11 and 5.47% of the total area respectively. Rajasthan ranks first in terms of production with a total production of 21.27 lakh MT followed by Andhra Pradesh (7.22), Gujarat (3.66), Madhya Pradesh (7.22), Karnataka (2.17), Orissa (2.16) and Tamil Nadu (1.9). The largest area under spices is in Rajasthan (24.27 lakh ha) followed by Madhya Pradesh (5.02), Gujarat (4.16), Andhra Pradesh (33.3), Kerala (2.92), Karnataka (2.42), Orissa (2.35), Tamil Nadu (1.44) and Maharashtra (1.12). The productivity (MT/ha) of the spices varies from 2.5 (Rajasthan), 2.4 (Maharashtra), 1.6 (Karnataka), 1.1 (Gujarat, Karnataka, West Bengal), 0.9 (Orissa, Tamil Nadu, Uttar Pradesh), 0.8 (Andhra Pradesh) and 0.5 (Kerala).

### Kala Zeera

#### Area and Production

Cumin is the seed of a small umbelliferous plant. The seeds come as paired or separate carpels, and are 3-6 mm (1/8-1/4 in) long. They have a striped pattern of nine ridges and oil canals, and are hairy, brownish in colour, boat-shaped, tapering at each extremity, with tiny

stalks attached. Many names are prevalent such as: *Fructus cumini*, *Cuminum cyminium*, Kamoun, Kamun, Siu wuih heung, Green cumin, White cumin, Cummin, Kreuzkümmel, Weißer Kreuzkümmel, Römischer Kümmel, Mutterkümmel, Jiru, Safaid jeera, Jirige, Jintan, Jintan putih, Jintan puteh, Jirakam, Duru, Suduru, Jirah, Zeera, Zira etc. Cumin is a most popular spice all over the world, especially in Latin America, North Africa and all over Asia, but least in Europe. Main production countries today are India, Iran, Indonesia, China and the South Mediterranean countries. India is the largest producer and consumer of cumin seed in the world. Cumin seed is almost exclusively cultivated in Rajasthan and Gujarat. India exports cumin seed to Bangladesh, Brazil, Japan, Malaysia, Nepal, Singapore, UAE, UK, USA and many other countries and cumin seed powder to UK, USA, etc. Out of the 80,000-170,000 tons of cumin grown in India every year, only 10% is actually exported. Kala Jeera is a spice which is popular in North Indian cuisine. Kala Jeera is also known as black cumin, which can be confusing, since several other seeds are also called "black cumin". The scientific name of true Kala Jeera is *Bunium persicum*, and the



Kashmiri Kala Jeera



seeds are small, dark brown, and crescent shaped, with a sharp, bitter odor before cooking or toasting. Like regular cumin, Kala Jeera is in the parsley family. The plant is native to Central Asia and Northern India, where it has been used in cooking for centuries. The seeds are also pressed to yield an essential oil which is used in some traditional medicinal practices.

The northern regions of India have ideal climatic conditions for cultivation of diverse plant species. Major parts of the regions has temperate climate where herbs of medicinal value and field crops requiring low temperature can be grown. There are more than 1000 herbs, including Kala Zeera in the wild in Himalayan valley, which is the hub of Kala Zeera. (*Bunium persicum* Bioss). (Syn *Carum 'brilbocastanum* L.) grows wild in some forest pockets in higher hills of Jammu & Kashmir and H.P. The sub-populations - because of geographical barriers - are maintained as land races and offer great potential of genetic variability. Potential for exploitation of genetic variability in the sub-populations (land races) exists which may help in the improvement for yield and quality parameters in this crop. Cultivation of *Bunium persicum* Bioss. and other species is mostly concentrated in the hilly areas of Gurez, Machil, Kargil, Drass, Leh, Paddar and foot hills in Jammu and Kashmir and Palampur, Kullu valley and Lahul Spitti of Himachal Pradesh. The area and production figures are not well documented for this crop. The average productivity level at Kashmir (129 Kg/ha) and H.P. (179 Kg/ha) is low when compared to 350-400 kg/ha obtained from annual types of *Carum* spp.

## Cultivation

The Zeera plant not only can be grown in fields, but can easily be cultivated on hill slopes, foothills and marginal lands. Therefore, more efforts are needed to make aware and train the farmers to grow Kala Zeera, not only to best utilize such lands but also to generate revenue (<http://etalaat.net/english/?p=99>).

## Composition

The fruits contain 2.5 to 4% essential oil. In the essential oil, cumin aldehyde (p-isopropyl-benzaldehyde, 25 to 35%), perilla aldehyde, cumin alcohol,  $\alpha$ - and  $\beta$ -pinene (21%), dipentene, p-cymene and  $\beta$ -phellandrene were found. In toasted cumin fruits, a large number of pyrazines has been identified as flavour compounds. It is used to flavor meat and rice dishes, with a distinct rich, nutty, slightly grassy taste. The seeds of *Cuminum nigrum* contain 8% flavonoids and 0.01% alkaloids. *C. nigrum* flavonoids possess insulin triggering and/or insulin-like properties (Mushtaq, 1999).

## Uses

Kala Zeera is said to be particularly helpful for digestive issues, and it is also used on some topical injuries such as boils. In some parts of India, the root of the plant is used in cooking as well. Before they are cooked, Kala Zeera seeds have a sharp, earthy, heavy scent which may be rather unpleasant. However, as they cook, the seeds develop a nutty flavor and scent which greatly enhances the appeal of the foods that they are cooked with. Kala Zeera may be baked into breads, added to curry pastes and blends, or steamed with rice to give it a distinctive scent,

especially in North Indian foods. When Kala Zeera seeds are not available, some cooks use toasted conventional cumin instead. Some people confuse black cumin with *Nigella*, an entirely unrelated spice. For an unknown reason, *Nigella* is sometimes also called as “black cumin”, although the two spices are not alike. *Nigella* is pungent and slightly bitter with a hint of sweet fruit, and the seeds are small, black, and sharply pointed. Bengali cuisine often incorporates *Nigella*, which is also known as black onion or fennel flower. All these names are misnomers, as *Nigella* is an exclusive genus, and it is a distinctive spice in its own right. As with all spices, Kala Zeera should be stored in a cool dry place, and preferably in dark. When you need Kala Zeera for a recipe, measure it from the storage container into a small dish, never add directly to cooking food, as the heat or humidity can get into the container and spoil the spice. Try to use Kala Zeera within six months to one year, and toast it before use if you want an especially strong, distinctive flavor.

Kala Zeera cultivars existing in J&K and Himachal Pradesh are rich in essential oil content and other volatile aromatic components and can be utilized in a holistic manner for essential oil/perfumery/cosmetic industries and as minor seed spice with economic returns ranging from ₹ 138,000/- to ₹ 175,000/- when solely disposed as seed spice. However the byproducts of Kala Zeera post harvest processing yield straw, stalk and inferior quality very small seeds which can be processed to yield essential oil (6-14 Kg/ha) with cumin flavor providing an additional revenue of ₹ 21,000/- to ₹ 49,000/- ha<sup>1</sup>. Raising through vegetative

propogules (zeera root tuber) from seed recorded highest germination percentage (75-82%) in pre-winter sowing as against post-winter with no germination confirming that this seed spice essentially requires a long pre-chilling period to overcome dormancy of seed sowing.

### Research opportunity

- Collection, maintenance, characterization at morphological, biochemical and molecular level and also the evaluation of temperate spice crops germplasm is required to be done at large scale.
- Crop diversification towards less perishable horticultural crops like Kala Zeera in temperate regions is essential to earn foreign exchange and reduce pressure on the available resources for creating additional infrastructure facilities.
- Isolation of different biochemical characters and their characterization is needed for their needful uses, like in medicine and nutrition.
- Molecular characterization of different Kala Zeera germplasm available at present is to be done as also use of tissue culture technique for mass multiplication of the crop.
- Training the farmers to grow Kala Zeera is required.
- Improvement with respect to yield and quality in existing germplasm is needed using breeding programmes and modern biotechnological tools.

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# Science of PIN Code

K.K. Devis

Most countries use a postal code system to deliver mails. In India, the Postal Index Number Scheme called PIN code was introduced on 15 August, 1972. PIN code is a system of numerical identification of a delivery post office.

PIN is a six-digit code allotted to all delivery post offices in the country. All head post offices and sub post offices which deliver mails are scientifically allotted their own six-digit numbers.



India - PIN Regions : First Digit



Therefore PIN code should appear in all documents connected with the transmission of mail.

How does PIN help in timely delivery of mail? The PIN code digits from left to right progressively pinpoint and locate the geographical location of the post office. The first digit represents a region in the country and the second, a sub-region.



Kerala Circle - PIN Code : First three digits

The third digit read with the first two digits indicates a sorting district. In short, the first three digits of a PIN code of the post office will clearly speak in which state and sorting district the post office is located. The last three digits pinpoint the post office of delivery within the district. Thus the six digits, all taken together, identify an individual post office as a delivery unit.

In a country with diverse language and scripts, the introduction of a digit code has eased the problems of sorting mails. Further, there are several post offices in

the country having the same name. The addition of the PIN code after the address enables the sorting personnel and Automatic Mail Processing Centre (AMPCs) functioning in Mumbai and Chennai to identify the destination correctly, thereby eliminating chances of missending and consequent delay to the article. When you add the PIN code it will reduce delay in transmission and will ensure correct delivery.

All should, therefore, make it a habit to add PIN in their address. All letterheads, letter pads, rubber stamps, receipts etc. should bear the PIN code of the delivery post office. When you set your signature in E mail, please add the PIN code also. This one-time exercise of adding your PIN of the delivery post office will have a telling effect in timely delivery of your mail. For details log on to [www.indiapost.gov.in](http://www.indiapost.gov.in)

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## *Role of Biosensors In Food Safety*

**N. Dhivya, D. Sankari, R.Yathavamoorthi, R. Vijayalekshmi, Dr. A. Surendraraj  
and Dr. K.H. Sabeena Farvin**

Food and waterborne diseases are the leading causes of illness and death in less developed countries, killing approximately 2.2 million people annually, of which 1.8 million are children. Deeply concerned by this, a resolution was adopted by World Health Organization (WHO) and its Member States to recognize food safety as an essential public health function, and to develop a Global Strategy for reducing the burden of food borne diseases. Biological (pathogenic bacteria, fungi, virus and parasites) and chemical hazards (pesticides, heavy metals, allergens and adulterants) are the major cause of these illnesses. Trend for processed food especially minimally processed foods lead to elevated risk of contamination with these disease causing agents.

Food and Agricultural Organization (FAO) of United Nations (UN) and WHO addressed the food safety issues along the entire food production chain from production to consumption using new methods of risk analysis. Risk is nothing but the hazard either chemical or biological in nature, which put the safety

of the food at stake. Detection and characterization of risk is essential for effective implementation of risk analysis, thereby preventing the food borne disease outbreaks.

### **Need for Biosensors**

Conventional techniques of chemical and microbial hazard detection require time consuming sample preparation, analysis, incubation and result development. For some of the hazards it may take 5-6 days for obtaining the result. However, food establishments and healthcare sector which do the monitoring work require the results in real time i.e. instantaneously. Microbial pathogen detection and identifications are modified from the time consuming plating and culturing methods to shorter formats such as immunological and nucleic acid techniques viz. Enzyme Linked Immunosorbant Assay (ELISA) and Polymerase Chain Reaction (PCR). A recent requirement for ensuring food safety is for a device which sense microbial and chemical hazards and delivers accurate and speedy results. Biosensor is one such device fulfilling the above criteria. The table given below gives the inherent beneficial aspects of a biosensor to make them a promising device of future in confronting foodborne outbreaks.

**Hazard is any physical, chemical and biological agent, which cause injury or illness when ingested by humans.**

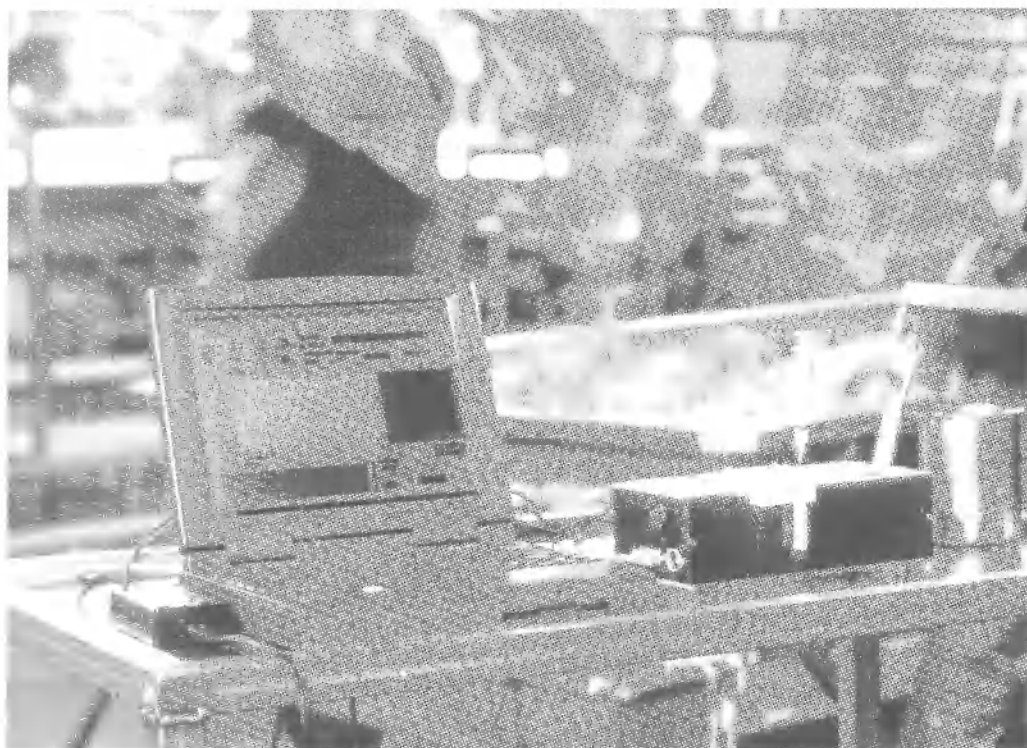
### Advantages of Biosensors

Cost	\$1-15 per analysis
Portability	Can be carried by one person; no external power
Assay time	1-60 minutes
Personnel training	Can be operated after 1-2 hour training period
Format	Reversible, continuous, <i>in situ</i>
Matrix	Minimal preparation for food, groundwater, soil extract, blood and urine
Sensitivity	Parts per million to parts per billion
Dynamic range	At least two orders of magnitude
Specificity	<i>Enzymes/receptors/nucleic acids:</i> Specific to one or more groups of related compounds <i>Antibodies:</i> Specific to one compound or closely related group of compounds

Biosensors represent a rapidly expanding field, in present days, with an estimated 60% annual growth rate; the major impetus coming from the health-care and food industry, but with some pressure from other areas, such as environmental monitoring. The estimated world analytical market is about \$ 12,000,000,000 year<sup>-1</sup> of which 60% is in the health care and food area. There is clearly a vast market expansion potential as less than 0.1% of this market is currently using biosensors.

### What is a Biosensor?

A biosensor is an analytical device composed of a biological sensing element (enzyme, receptor antibody or DNA) in intimate contact with a physical transducer (optical, mass or electrochemical) which together relate the concentration of an analyte to a measurable electrical signal.



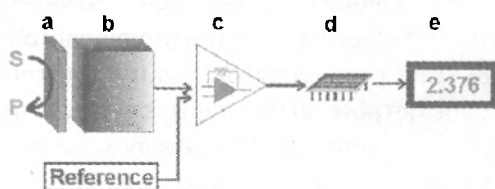


## Parts of a Biosensor

Biosensor essentially consist of three parts:

- **Sensitive biological element** - (eg. tissue, microorganisms, organelles, cell receptors, enzymes, antibodies, nucleic acids, etc.).
- **Transducer or Detector element**- (works in a physicochemical way) that transforms the signal resulting from the interaction of the analyte with the biological element into another signal.
- **Signal processors** - responsible for the display of the results in a user-friendly way.

The block diagram of a typical biosensor is given below. In this picture, the biocatalyst (a) converts the substrate (s) to product (p). This reaction is determined by the transducer (b) which converts it to an electrical signal. The output from the transducer is amplified (c), processed (d) and displayed (e).



## Classifications of Biosensors

The key part of a biosensor is the transducer (b) which makes use of a physical change accompanying the reaction. There are different types of transducers and biosensors can also be classified into different types:

1. The heat output (or absorbed) by the reaction - calorimetric biosensors.
2. Changes in the distribution of charges causing an electrical potential to be produced-potentiometric biosensors.
3. Movement of electrons produced in a redox reaction - amperometric biosensors.
4. Light output during the reaction or a light absorbance difference between the reactants and products - optical biosensors,
5. Effects due to the mass of the reactants or products - piezo-electric biosensors.

Biosensors are also classified into three generations. First generation biosensors where the normal product of the reaction diffuses to the transducer and causes the electrical response, second generation biosensors which involve specific 'mediators' between the reaction and the transducer in order to generate improved response, and third generation biosensors where the reaction itself causes the response and no product or mediator diffusion is directly involved.

## Biosensors in food analysis

There are several applications of biosensors in food analysis. In food industry optics coated with antibodies are commonly used to detect pathogens and food toxins. The light system in these biosensors has been fluorescence, since this type of optical measurement can greatly amplify the signal. A range of immuno - and ligand-binding assays for the detection and measurement of chemical contaminants (drug residues) such as sulfonamides and Beta-agonists, pesticides of different category and growth promoters have been developed. Biosensors for the detection of most common food born pathogens like *Salmonella*, *E. coli* 0157:H7, *Listeria monocytogenes*, *Campylobacter jejuni* and *Yersenia enterocolitica* is available.

Recently a biosensor is developed which can simultaneously detect 12 different pathogens.

### Biosensors in health care system

Health care sector is another important area where in biosensors are mostly commonly used for Glucose monitoring in diabetes patients and other medical health related targets. Biosensors find application in the routine analytical measurement of Folic acid, Biotin, Vitamin B12 and Pantothenic acid as an alternative to microbiological assay.

### Biosensors in environmental monitoring

Environmental applications are for the detection of pesticides and river water contaminants, determination of levels of toxic substances before and after bioremediation. Biosensors are also used in remote sensing of airborne bacteria, drug discovery and evaluation of biological activity of new compounds and protein engineering.

### Advantages of Biosensors

Biosensors have several potential advantages over other methods of analysis such as:

- Sensitivity in the range of ng/mL for microbial toxins and <100 colony-forming units/mL for bacteria.
- Fast or real-time detection can provide almost immediate interactive information about the sample tested, enabling users to take corrective measures before consumption or further contamination can occur.
- Miniaturization of biosensors enables biosensor integration into various food production equipment and machinery.
- Potential uses of biosensors for food microbiology include online process microbial monitoring to provide real-

time information in food production and analysis of microbial pathogens and their toxins in finished food.

- Biosensors can also be integrated into Hazard Analysis and Critical Control Point programmes, enabling critical microbial analysis of the entire food manufacturing process.
- The biosensor will help in overall quality control in food processing plants. It would minimize the chance of the final product being contaminated.

### Conclusion

The food industry needs suitable analytical methods for process and quality control; that is, methods that are rapid, reliable, specific and cost-effective in their provision of information about physical and chemical characteristics of food. Apart from a few important analytes, such as sugars, alcohols, amino acids, flavours and sweeteners, food applications mainly focus on the determination of contaminants. However, very few biosensors play a prominent role in food processing or quality control. Considerable effort must be made to develop biosensors that are inexpensive, reliable, and robust enough to operate under realistic conditions.

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# HISTORY OF DRUG DISCOVERY FROM NATURAL PRODUCTS

Dixon Thomas, Molly Mathew and Seeba Zachariah

At the present days even though synthetic medicines are dominating the drug market, medicines or its raw materials from natural sources are available in abundance. Statistics shows that nine out of the 20 leading drugs in 1999 were derived from natural products. Almost 40% of the 520 new drugs approved for the public use between 1983 and 1944 were natural or materials derived from natural sources. Greater than 60% of the anticancer or antimicrobial medicines in the market were derived from natural resources. In fact the scope of finding new medicines from natural sources is of no decrease from the past. This may be because of the natural defense mechanisms various organisms or plants play against other organisms. One of the key modes of survival is by producing toxic chemicals against other organisms. As an example, a natural fungal product (the antibiotic Penicillin) is produced against bacteria or other fungi to inhibit their growth near to where the fungi grow. Chemical alterations of the natural chemicals will produce drugs of better efficacy and

**Greater than 60% of the anticancer or antimicrobial medicines in the market were derived from natural resources. In fact the scope of finding new medicines from natural sources is of no decrease from the past**

safety. They could be termed as semi-synthetic medicines or drugs derived from natural sources. With the advancements in laboratory techniques in chemically modifying and synthesizing new medicinal chemicals now a day's drug development became a major role of medicinal chemist. But beyond doubt, it is a multidisciplinary effort including the expertise of a botanist, biologist or microbiologist also in recognizing the medicinally active chemicals from natural sources (Richard, 2004).

The medicinal use of natural products - compounds that are derived from natural sources such as plants, animals or micro-organisms - precedes recorded human history probably by thousands of years. Palaeo-anthropological studies at the cave site of Shanidar, located in the Zagros Mountains of Kurdistan in Iraq, have suggested that more than 60,000 years ago, Neanderthals were aware of the medicinal properties of various plants, as evidenced by pollen deposits in one of the graves at the site (Ji *et al.*, 2009).

## Pharmacognosy

Pharmacognosy is one of the oldest established pharmaceutical sciences, referred to as the investigation of medicinal substances of plant, animal, or mineral origin in their crude or unprepared state. By the middle of the 20<sup>th</sup> century, the chemical composition of the drugs started to be discussed in detail. Today the subject Pharmacognosy is highly interdisciplinary, and it incorporates aspects of analytical chemistry, biochemistry, biosynthesis, biotechnology, ecology, ethnobotany, microbiology, molecular biology, organic chemistry and taxonomy. American Society of Pharmacognosy defines it "as the physical, chemical, biochemical and biological properties of drugs, drug substances, or potential drugs or drug substances of natural origin, as well as the search for new drugs from natural sources."

## Drug discovery

The actual documentation of drugs derived from natural sources in western world appears to date back as to the Summerians and Akkadians in the third century BC as well as to the Egyptian Ebers Papyrus approximately 1,600 BC. Other important contributions on the uses of drugs of natural origin were documented by Dioscorides (*De Materia Medica*) and Pliny the Elder in first century AD and by Galen in second century AD. Written documents also exist from about

the same period showing evidences of plants used in both Chinese traditional medicines and Ayurvedic medicines. Approximately 500 years ago information concerning medicinal plants was documented in herbals and laboratory studies on natural products start to appear from around 200 years ago. One of the Preliminary works was isolation and

**'Prodrug' refers to an inactive chemical which undergo chemical transformation in the body and produce a medicinally active metabolite which works in the body.**

**Many of the natural products have Prodrug nature so that they have medicinal value only after getting absorbed in the body. There is another concept about drug known as Hard drugs and Soft drugs.**

purification of Morphine from opium plant. This corresponds with the beginnings of organic chemistry as a scientific discipline. Additional drugs isolated from plant sources in the 19<sup>th</sup> century included Atropine, Caffeine, Cocaine, Nicotine, Quinine and Strychnine. And followed the isolation of Digoxin, Reserpine, Paclitaxel, Vincristine and chemical precursors of the steroid hormones in 20<sup>th</sup> century. In the present century, approximately three-quarters of the world's population is reliant on primary health care from systems of traditional medicine, including the use of herbs. In recent years, a more profound understanding has emerged

of the chemical and biological aspects of plants used in the traditional medicine of countries such as the People's Republic of China, India, Indonesia, and Japan in addition to medicinal plants used in Latin America and Africa.

At the beginning of the 21<sup>st</sup> century, there was much interest in the discovery and development of drugs from marine





animals and plants. But only few medicines emerged from marine sources even though ocean occupies 70% of the earth surface (Douglas, 2008).

'Prodrug' refers to an inactive chemical which undergo chemical transformation in the body and produce a medicinally active metabolite which works in the body. Many of the natural products have Prodrug nature so that they have medicinal value only after getting absorbed in the body. There is another concept about drug known as Hard drugs and Soft drugs. Hard drugs do not undergo metabolism or chemical transformation in the body so that they are accumulated in the body after repeated use. Metabolism of the drug is required in the body for its easy excretion from the body after exerting the intended action. Soft drugs are such kind of medicines which show medicinal action and then they are chemically changed in to inactive forms which could be easily excreted from the body. Functionally Soft drugs are opposite to that of Prodrugs since that Prodrugs after metabolism become more medicinally active chemicals, were as Soft drugs become less medicinally active chemicals.

According to a study by Grifo and colleagues, 84 out of a representative 150

prescription drugs in the United States fell into the category of natural products and related drugs. They were prescribed predominantly as anti-allergy/pulmonary/

respiratory agents, analgesics, cardiovascular drugs, and for infectious diseases. Another study found that natural products or related substances accounted for 40%, 24%, and 26%, respectively, of the top 35 worldwide ethical drug sales during 2000, 2001, and 2002. Of these, natural product-based drugs, Paclitaxel (ranked at 25 in 2000), a plant-derived anticancer drug had sales of \$1.6 billion in 2000. The sales of two categories of plant-derived cancer chemotherapeutic agents were responsible for approximately one third of the total anticancer drug sales worldwide, or just under \$3 billion dollars in 2002; namely, the Taxanes, Paclitaxel and Docetaxel, and the Camptothecin derivatives, Irinotecan and Topotecan (Chin *et al.*, 2004).

### Accidental drug discovery

There are exciting stories behind many accidental drug discoveries. Sir

Alexander Fleming's accidental discovery of the antibacterial properties of Penicillin in 1929 has largely stimulated the modern antibiotic era of drug development. Fleming and his colleagues discovered the

**There are exciting stories behind many accidental drug discoveries.**

**Sir Alexander Fleming's accidental discovery of the antibacterial properties of Penicillin in 1929 has largely stimulated the modern antibiotic era of drug development. Fleming and his colleagues discovered the inhibition of growth of one bacterial culture which was accidentally contaminated with *Penicillium notatum* (The organism responsible for the production of Penicillin antibiotic).**

inhibition of growth of one bacterial culture which was accidentally contaminated with *Penicillium notatum* (The organism responsible for the production of Penicillin antibiotic). Use of Penicillin as an antibiotic in treatment of bacterial infections was exploited in 1938 after the death of Fleming. Centuries earlier humans have used plant extracts against bacterial infections which were supposed to have antimicrobial chemicals (which are used by plants to survive from bacterial or fungal infections). As early as 500 to 600 BC, molded curd of soyabean was used in Chinese folk medicine to treat skin infections by microorganisms. Pasteur and Joubert discovered in 1877 that Anthrax bacilli are killed when grown along with certain other bacteria. Then Vuilemin defined antibiosis as the biological concept of survival of the fittest, in which one organism destroys another to preserve itself (Forrest and Randall, 2004).

### Some drug developing nations

Japan was the third country, after the United States and the United Kingdom, to become self-sufficient in manufacturing Penicillin. In addition to Penicillin, there was an enormous amount of national exploratory research focusing on anti-infective, anti-cancer and agricultural antibiotics. Here is a summary, a brief chronology of discoveries. The first few antibiotics from Japan were Colistin (1950), Mitomycin C (1955), Kanamycin (1957), Bleomycin (1965), Cefazolin (1969), Amikacin (1972), Piperacillin (1976), Norfloxacin (1977), Cefoperazone (1978), Ofloxacin (1980), Clarithromycin (1984), Meropenem (1987), etc. (Cooper, 2004).

In conclusion it could be seen that there were many medicinal preparations

in India as part of the Indian traditional medicine but there was no noted identification of medicinally active chemicals from our natural sources. Even though we have a rich history of Ayurveda and other medicine system, there were no drugs in chemical form discovered or isolated from natural or synthetic sources in India. We were using natural products as medicines but were not interested to isolate drugs chemically from it until recent past. There are some medicinally active chemicals in the final stages of drug discovery by the Indian pharmaceutical companies at present. Let us hope for a better future by working on more to discover new drugs from India.

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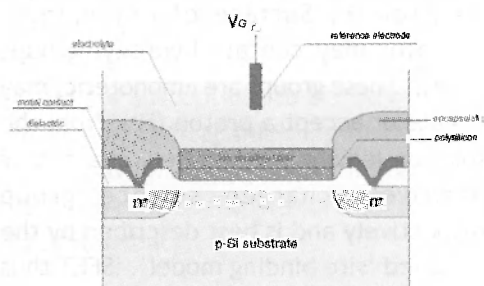
# ION SENSITIVE FIELD EFFECT TRANSISTORS

C.K. Sunith

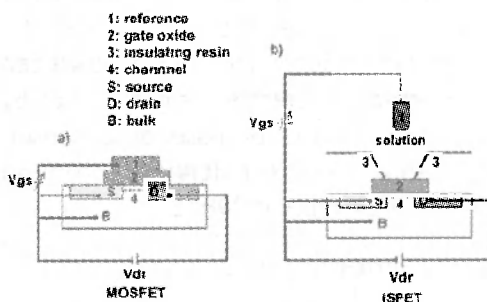
Field Effect Transistors have been in use in electronic circuits for quite a long time. The phenomenon called 'field effect' was discovered long back, but it was K. D. Wise of Stanford University who put forward the idea of making use of field effect in sensors. In fact, the introduction of silicon as a substrate for microelectrodes, especially for electrophysiological measurements was investigated in the late 60's by Wise. However, this JFET based approach did not find use in sensors. Later, Dr. P. Bergveld, popularly known as the 'Father of Ion Sensitive Field Effect Transistors (ISFETs)' introduced the concept of MOSFETs for use in silicon sensors to measure ion concentration wherein the metal gate electrode was replaced by a reference electrode inserted in an aqueous solution in contact with gate oxide. The device came to be popularly known as ISFET. Nearly at the same time, a Japanese student at Stanford University, Matsuo was working on similar lines. Small dimensions permitted the use of ISFET's for use as sensors for biomedical applications. However, researches on ISFET went in the direction of ion sensing in general.

ISFET is obtained by replacing standard metal gate of MOSFET with a reference electrode, a chemically sensitive insulator between which is present a measured electrolyte (analyte). The gate voltage is applied to reference electrode and the

electrolyte closes the electric gate-source circuits. ISFETs have a MOSFET like structure where the source and drain leads as well as chip edges have to be encapsulated leaving gate area open.



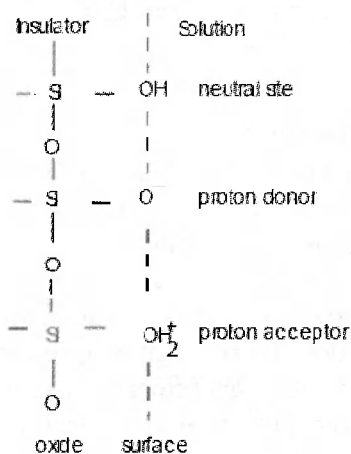
*The structure of an ISFET*



*MOSFET vs ISFET*

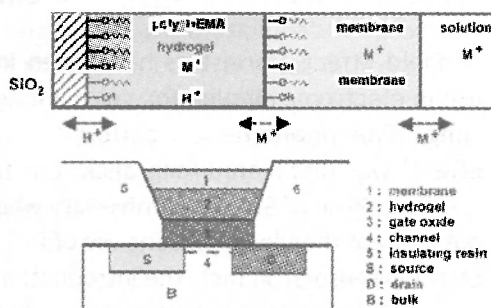
The introduction of electrolyte between reference electrode and insulator results in formation of two junctions - the liquid junction between the reference electrode and the electrolyte and electrolyte-insulator junction. These junctions give rise to two more potentials across the two junctions of which, the potential developed across the liquid junction is nearly a constant, depending on the type of electrode.

Electrolyte-insulator interface potential, called the surface potential is our parameter of interest. Surface potential results from a chemical reaction, usually governed by dissociation of oxide-surface groups. It is this parameter which makes ISFET sensitive to electrolyte pH. The surface potential so developed may change the threshold voltage of the device. This surface potential is the result of interaction of the insulator surface with ions (or charges) present in the electrolyte and mainly depends on the hydrogen ion concentration of the electrolyte. Surface of any oxide-insulator may contain hydroxyl groups ( $\text{SiOH}$ ). These groups are amphoteric, may donate or accept a proton ( $\text{H}^+$ ) from the solution leaving a negatively charged or positively charged surface group respectively and is best described by the so called 'site binding model'. ISFET thus acts as a sensor where signal transduction is a function of the state of ionization of insulating surface. To put into words, the aggregate of ionic activity has now been converted into electrical signal, which by definition is the purpose of a sensor. The maximum sensitivity achieved was  $-59.2\text{mV/pH}$  at  $298^\circ\text{K}$ .



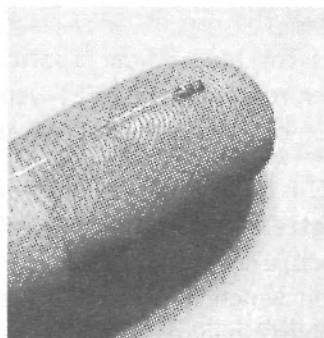
*Schematic representation of the site-binding model*

Introduction of additional layers to the gate stack would help the device improve pH sensitivity. The membrane to be used will depend upon the ion for which measurement of concentration is to be carried out. For example, PVC containing Valinomycin is sensitive to potassium ion concentration.



*Gate stack of ISFET*

If the applied gate is fixed, changes at the solution-electroactive material interface are reflected as changes in drain current. ISFET can form a part of bridge read out for measurement. If the drain current is held constant using an operational amplifier with negative feedback, changes in feedback voltage required to maintain a constant drain current will be the focus of measurement. Calibration of the device involves successive immersion in two buffer solutions with a different pH/ion concentration with which both offset and sensitivity can be adjusted.



*ISFET*



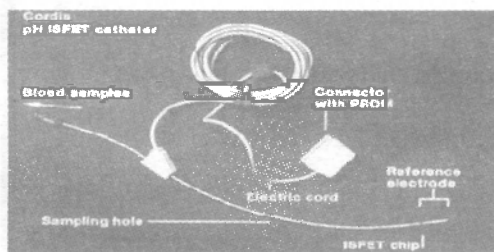


## ISFET Applications

ISFETs were primarily meant for pH measurement of blood. An ISFET catheter assembly was made by Cordis in Netherlands. ISFET was mounted behind a side window at the tip of catheter. The reference electrode has to be brought into contact with blood for at least half an hour before signal conditioner produces pH results. The data stored in an associated PROM connector was used by floating signal conditioner to convert ISFET output to blood pH. Accuracies of the order of 0.001pH have been achieved. However, owing to bio-incompatibility, the catheter tip was later withdrawn from the market.



*ISFET pH Meter*



*pH ISFET Catheter*

Coulometry is an absolute method of ion generation. ISFETs have been successfully used in coulometric titration where the pH of a solution was constantly monitored and controlled. By employing an enzyme trapping membrane upon gate structure, ISFETs can behave as an enzyme sensors. The excellent stability and cheapness of 'urease' makes it an ideal enzyme - sensitive membrane.

## Merits and Demerits

Advantages of small dimensions, high speed, good sensitivity, user-friendliness and amplifying power of FETs apply to ISFETs also in general. ISFETs are robust and durable. ISFET probes can be cleaned using a toothbrush. The device requires minimum maintenance and have wider temperature ranges. ISFETs can be mass produced by MOSFET and similar processes and can be made multifunctional. Furthermore, ISFETs are sterilizable.

Despite these advantages, ISFET catheters are bio-incompatible. They are vulnerable to environmental poisoning of gate and are susceptible to breakdowns. Again lack of optical shielding results in light sensitivity, which is not desirable. Limited life time of the membranes is yet another drawback.

Since the response of ISFETs to ionic concentrations was reported by Dr. Bergveld, the device has drawn the attention of the scientist community world wide. By substituting different sensitive membranes for MOSFET metal grid, different kinds of ISFETs sensitive to a variety of ions have been developed. The use of palladium gate electrodes to minimize light sensitivity (at the cost of sensitivity!) has resulted in the fabrication of the so called 'CHEMFETS' for ionic measurements. Ion sensitive sensing devices can be used for chemical, physiological and biomedical measurements as well as environment protection and industrial control.

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# SCIENCE INDIA QUIZ

Send the correct answers to Science India office or to arsmenon@gmail.com/scienceindia2010@gmail.com latest by 20th January, 2011. A science book as prize awaits you. If there are more than one correct entries, the winner will be selected by draw of lots

-Editor

## SCIENCE INDIA QUIZ NO. 15

1. Red Shift in stars is due to -----
2. DNA structure was first described by -----
3. The National Herbarium of India is located at -----
4. A body when immersed in a liquid experiences an upward thrust equal to the weight of the liquid displaced by it. This is -----
5. Aspirin is prepared from -----
6. Haversian canals are found in -----
7. The study of form, structure and arrangement of plant organs
8. Metal commonly used for making an electromagnet
9. The compound eye of insect produces ----- vision
10. Prothrombin which helps in clotting of blood is released by -----

### Answers to Quiz No. 14

1. Chandrasekhar 2. Acetic acid 3. Pituitary 4. Chlorophyll 5. Oersted 6. Tyndall Effect 7. Protista 8. Total internal reflection 9. Change of triplet condition 10. Liver and muscles

The winner is Master George Joseph, St. Thomas High School, Palai.  
**CONGRATULATIONS!!!**

# BOOK OF THE MONTH

## The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements



Title	: The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements
Author	: Sam Kean
Publisher	: Little, Brown and Company
Pages	: 400
ISBN	: 10-0316051640

Few of us would ever associate the periodic table of the elements with high intrigue. The story of how we came to discover and understand the elements touches on topics that range from the hot centers of stars to human folly. The Periodic Table is one of man's crowning scientific achievements. But it's also a treasure trove of stories of passion, adventure, betrayal, and obsession.

The author Sam Kean clusters the elements not just by their Physics, but by their character. There's a "Poisoner's Corridor" chapter that follows a hapless geek into a radioactive misadventure, for example, and a great economics lesson offered through the rise of aluminium. Literature buffs might be surprised to learn of Goethe's own connections with the early history of the periodic table, from the chapter "Artistic Elements".

We learn that Marie Curie used to provoke jealousy in colleagues' wives when she'd invite them into closets to see her glow-in-the-dark experiments. And that Lewis and Clark swallowed mercury capsules across the country and their campsites are still detectable by the poison in the ground. Why did Gandhi hate iodine? Why did the Japanese kill Godzilla with missiles made of Cadmium? And why did Tellurium lead to the most bizarre gold rush in history?

Collective, the tales of "The Disappearing Spoon", do, however, convey an uneasy sense of just how many human lives have been lost over our ignorance of the elements. Sure, there are plenty of exploding lab incidents throughout history, but there are also mass poisonings and other atrocities that could have been prevented with simple scientific understanding. Kean leaves readers with a satisfying evolutionary sense of the periodic table and its future.

He describes the rise of the semiconductor industry; the connection of wars to the discovery of new elements; and the practice in colonial America of putting a silver coin in a milk jug to prevent the milk from spoiling. Readers also learn that Wilhelm Rontgen thought he had gone insane when he first discovered X-rays; and that the talented chemist Maria Goeppert-Mayer was nevertheless billed as a "mother" rather than a scientist when she won the Nobel Prize.

**N.S. Arun Kumar**

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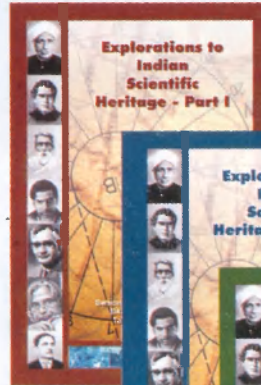
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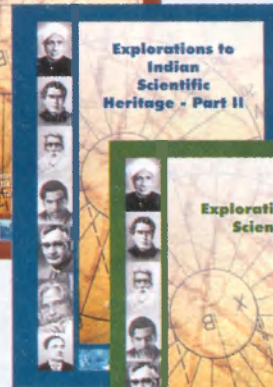


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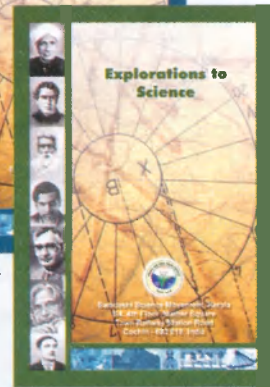
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